PERITONEUM, STOMACH AND DUODENUM

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Lecture (2) – Last updated: May 2013

Objectives:

- **Basic anatomy, to identify:**
    - Peritoneal layers, mesenteries ligaments and omenta.
    - Location, blood supply, lymphatic drainage and innervation of the lower esophagus, stomach and duodenum.
- **Surface anatomy, to define:**
    - The locations o the stomach and duodenum with regards to the 9 areas of the anterior abdominal wall.

- **Clinical anatomy, to define:**
    - Ascites
    - Paracentesis
    - Peritoneal Adhesions
    - Peritonitis
    - Esophageal constrictions.
    - Esophageal Varices.
    - Gastric ulcer.
    - Duodenal ulcer
- **Radiology:**
    - To interpret about Air under the right dome of the diaphragm.

Think About This

- **Khadija is 65 years old house wife presented to Omdurman Hospital with hematemesis and severe abdominal pain, her son told the doctor that she had suffered from epigastric pain that gets worse when she is hungry, she has past medical history of duodenal ulcer, the doctor responded immediately to stabilize the patient with necessary measures of resuscitation including fluids replacement.**

By The End Of This Lecture, Try To Answer These Questions About The Previous Story:

1. **Mention the organs that lie in the epigastric area.**
2. **Mention the possible blood vessel that could be responsible for the hematemesis. (Hint: the cause of hematemesis is a perforated ulcer)**
3. **Mention the anatomical relations of the first part of the duodenum.**

Introduction: Lecture's Map

- **Peritoneum.**
- **Lower esophagus.**
- **Stomach.**
- **Duodenum.**

Peritoneum

- Layers.
- Mesenteries and arrangement of organs.
- Peritoneal cavity.
- Innervation of the peritoneum.
- Ligaments of the peritoneum.
- Omenta.
- Greater and lesser sacs.

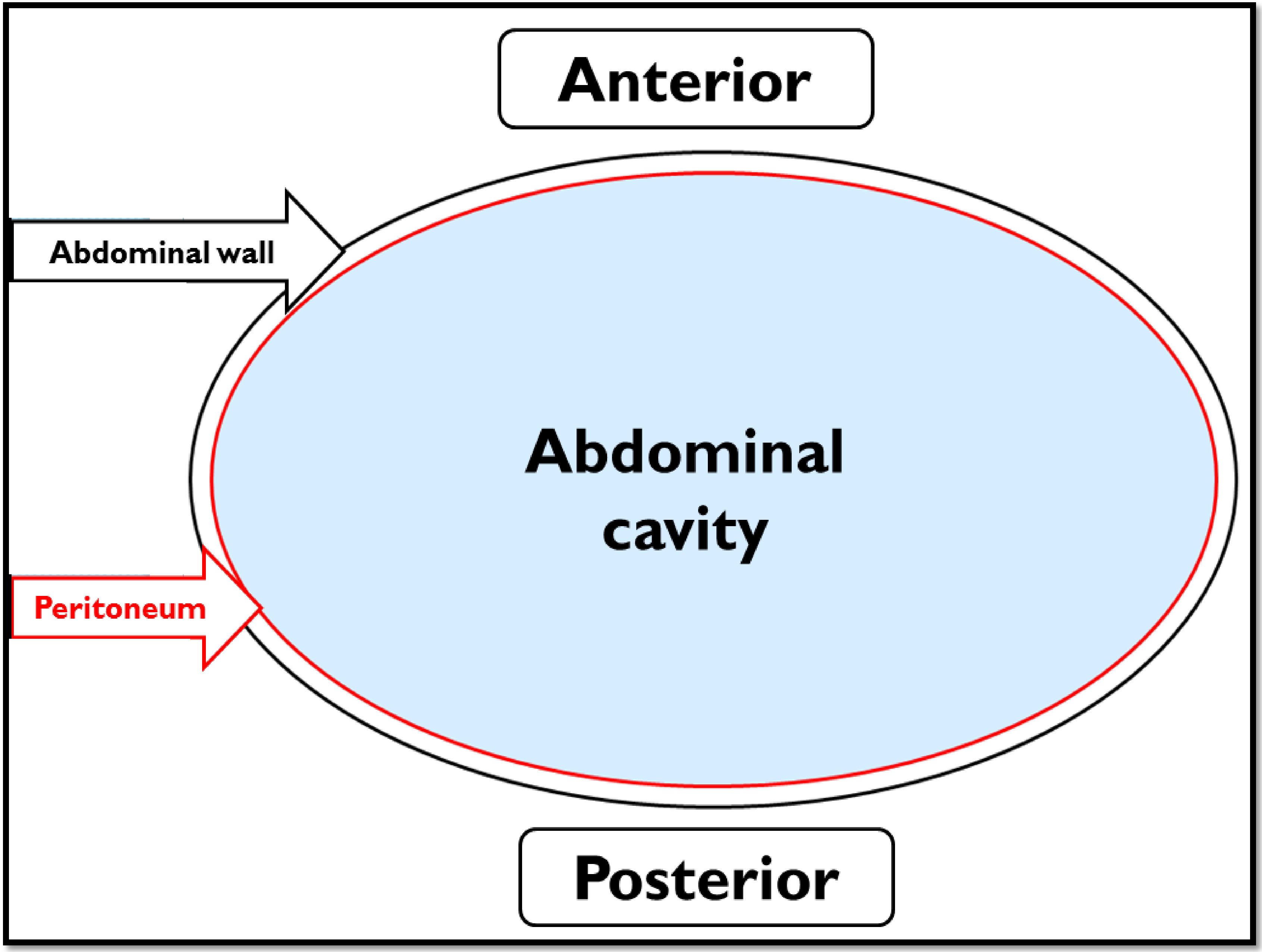
Peritoneum

- It is a thin serous membrane lines the walls of the abdominal cavity.

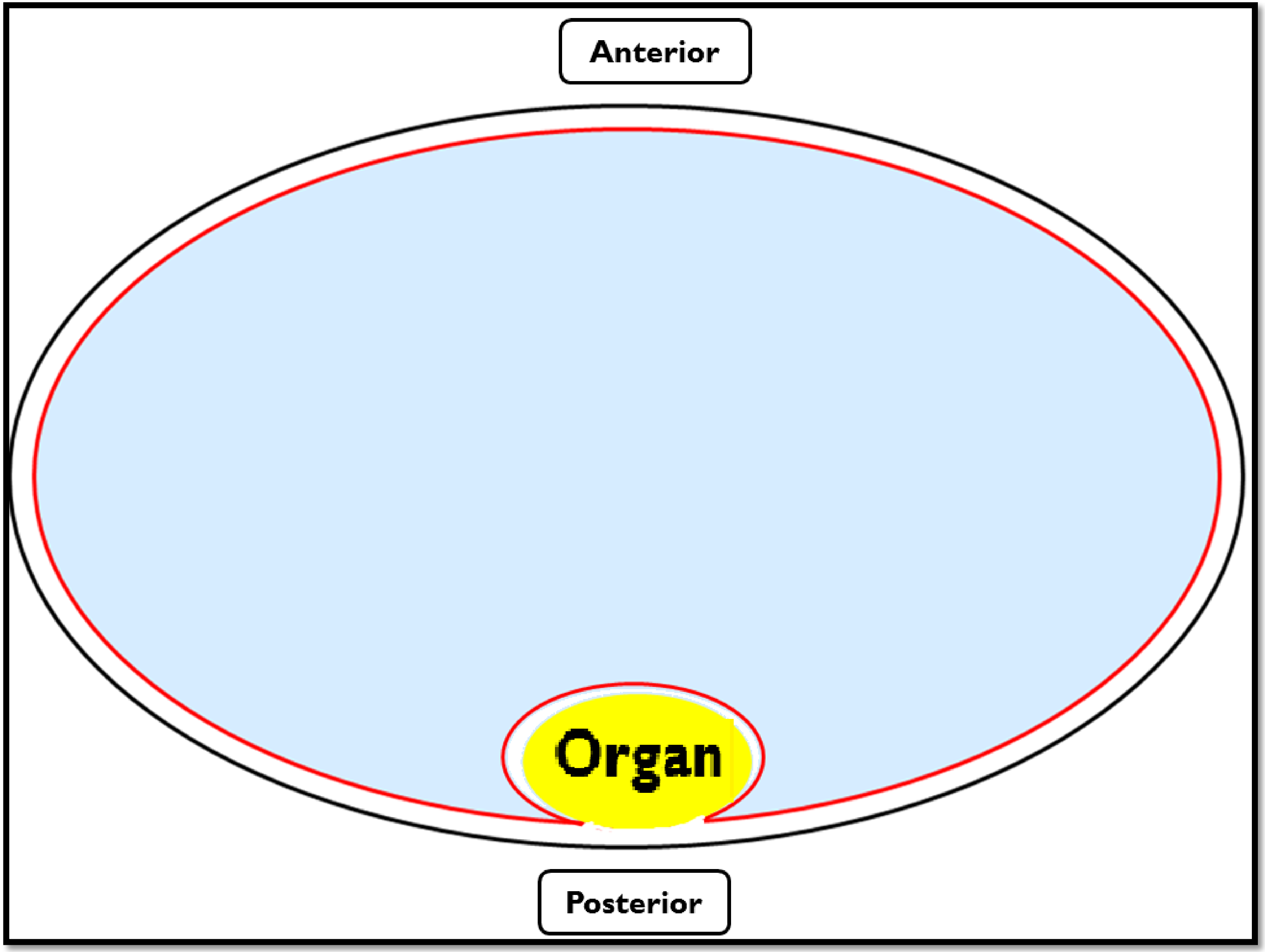
Two Layers:

- **Parietal peritoneum:**
  - **The peritoneum lining the walls of the abdomen.**
- **Visceral peritoneum:**
  - **The peritoneum covering the viscera.**

- To understand the way of formation of the two layers of the peritoneum, the following drawing from (1) to (5) will explain.


Anterior
Abdominal wall
Abdominal cavity
Peritoneum
Posterior

2



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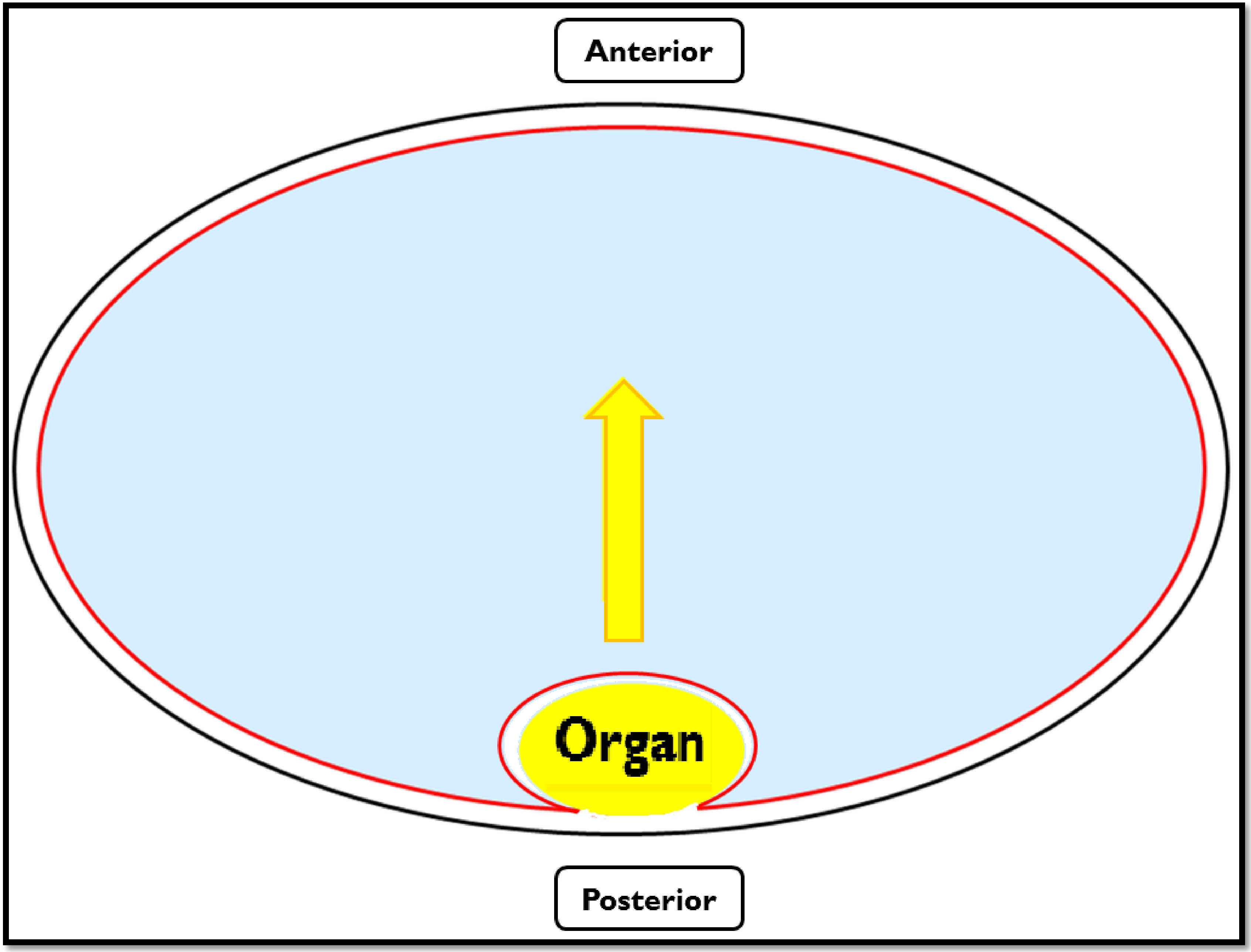

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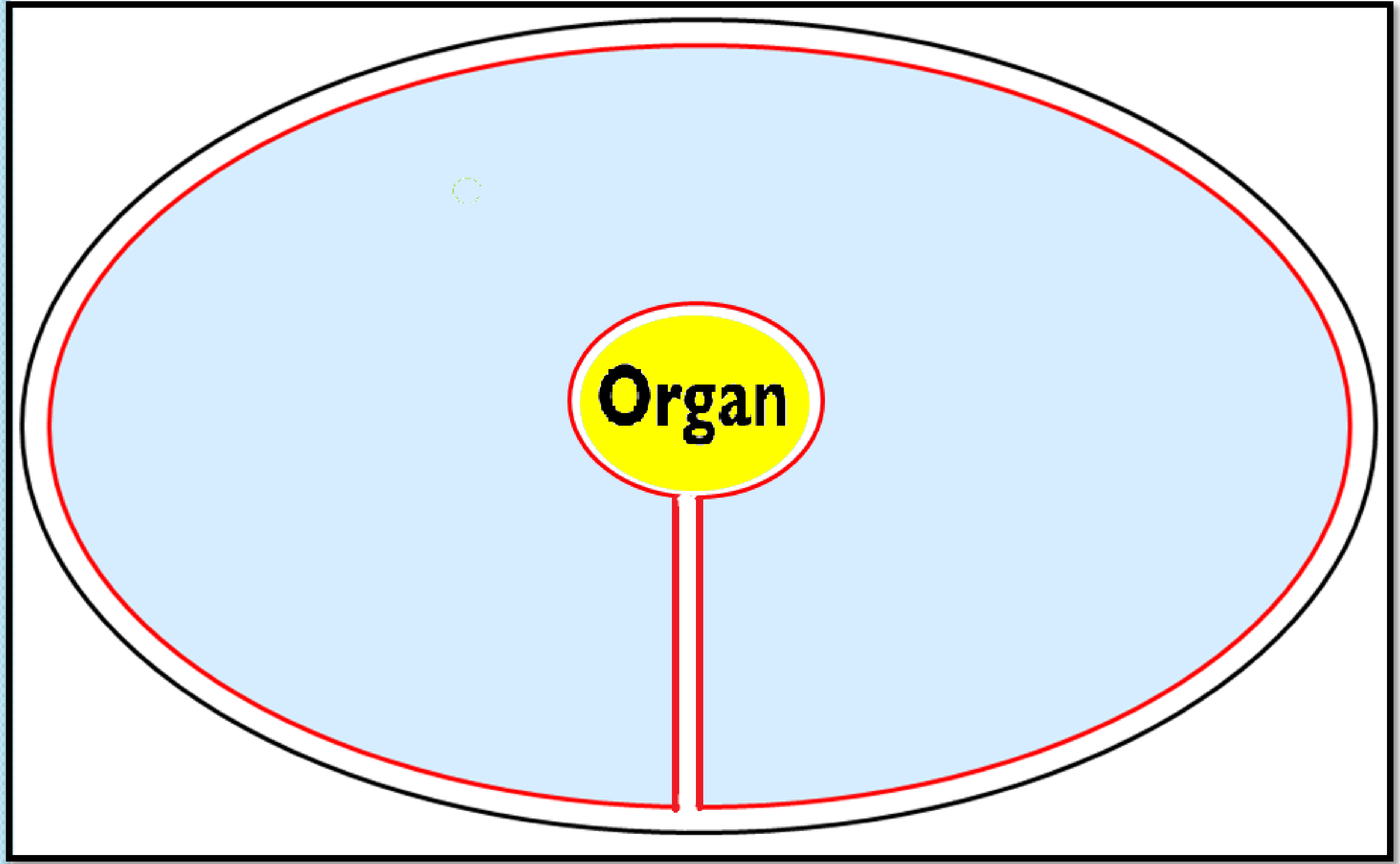

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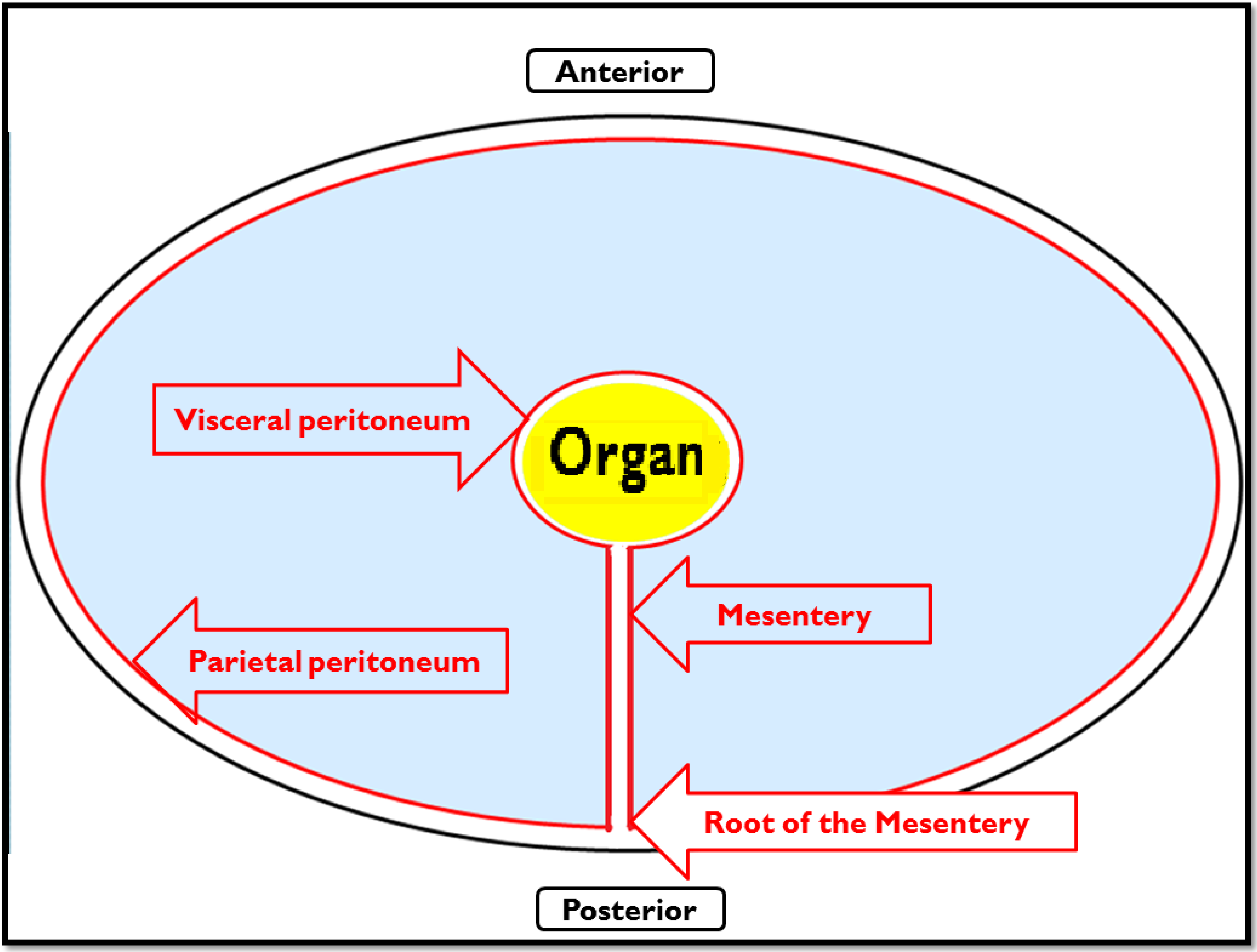
Anterior
Visceral peritoneum
Organ
Mesentery
Parietal peritoneum
Root of the Mesentery
Posterior

Peritoneum

- Layers.
- Mesenteries and arrangement of organs.
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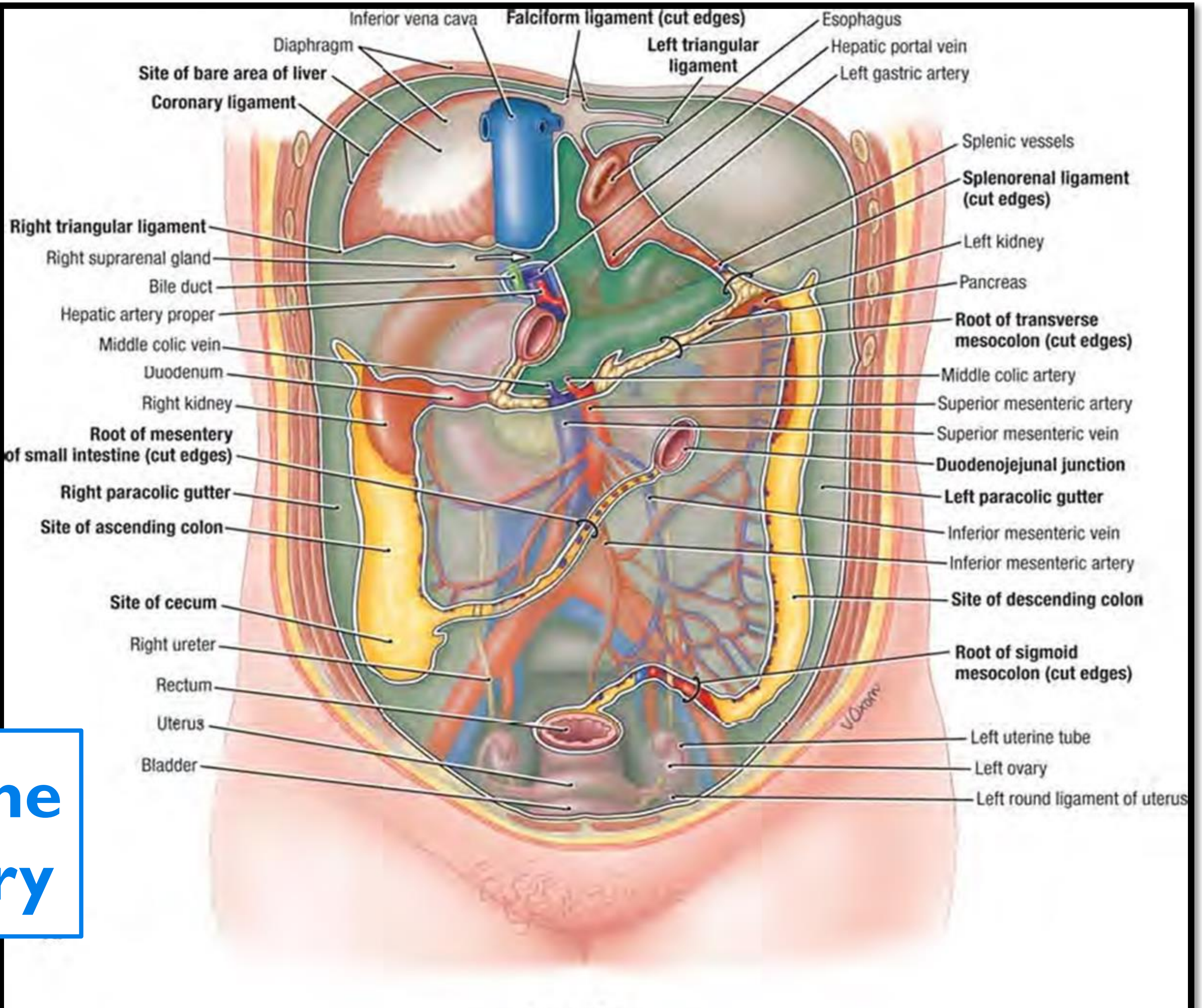
- Ligaments of the peritoneum.
- Omenta.
- Greater and lesser sacs.

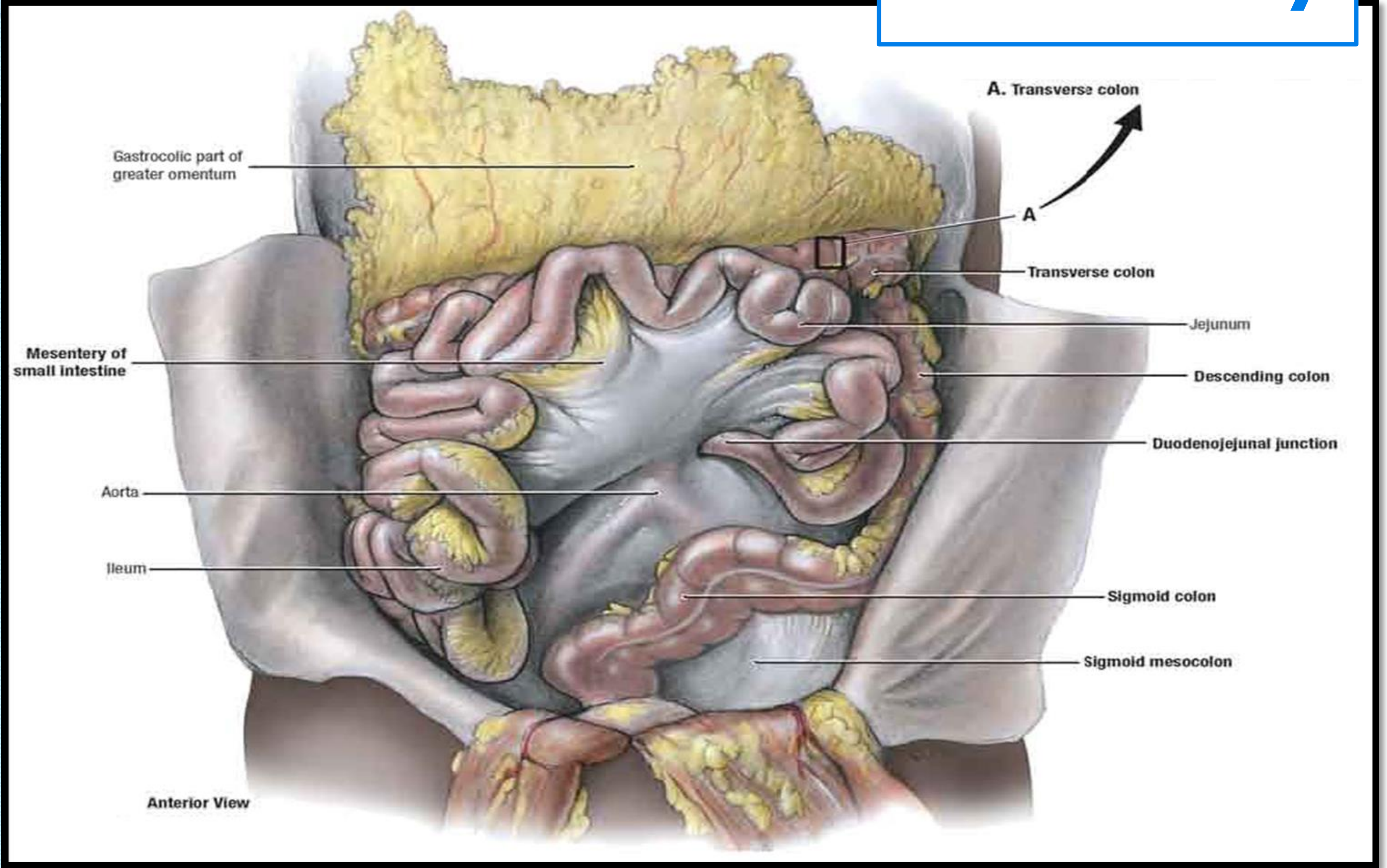
Root of the mesentery



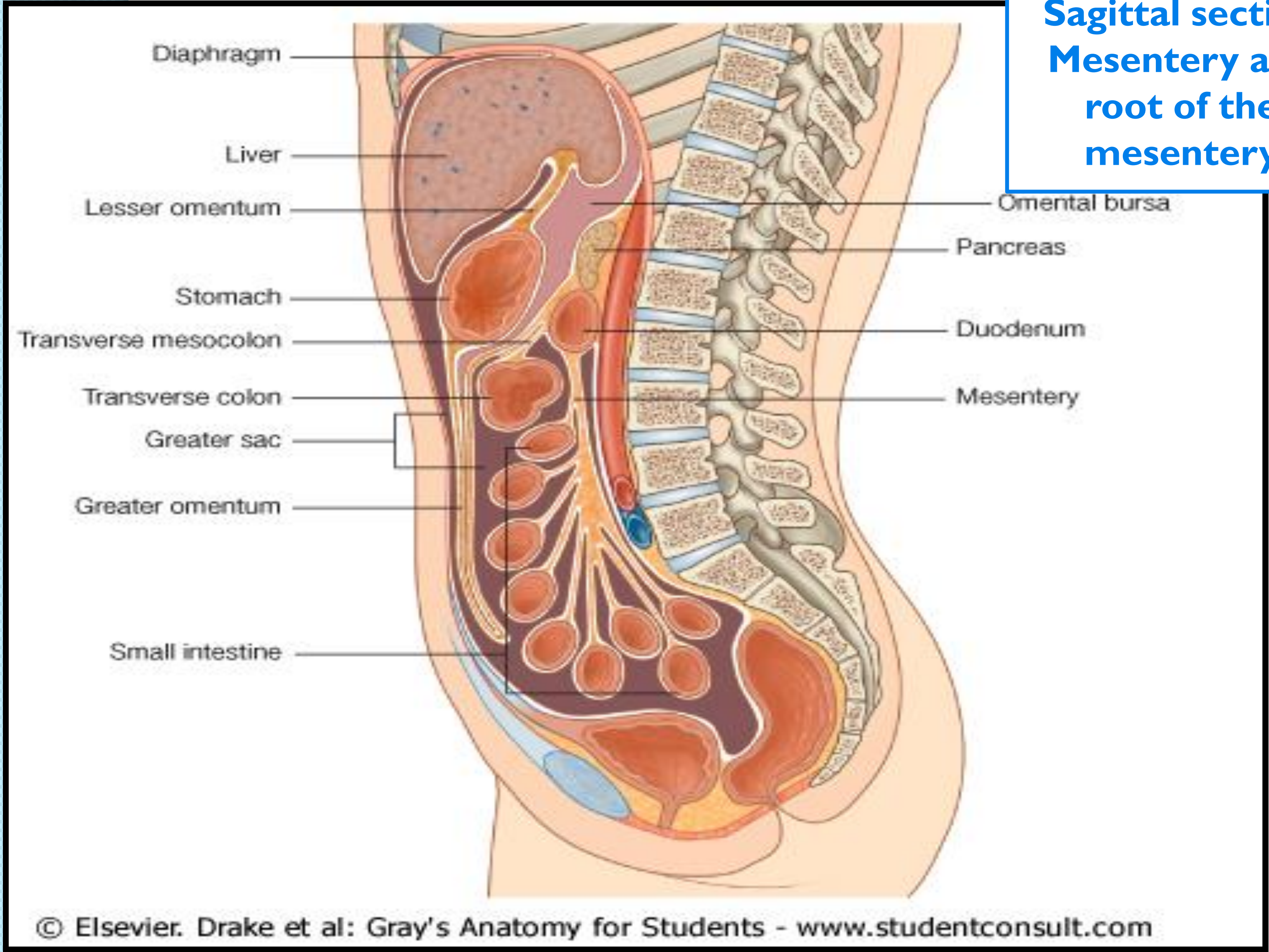
Anterior Views

Image from: Agur, Anne M.R.; Dalley, Arthur F. Grant's Atlas of Human Anatomy. 12th Ed. Lippincott Williams & Wilkins; 2009.

Mesentery


A. Transverse colon
Gastrocolic part of greater omentum
A
Transverse colon
Jejunum
Mesentery of small intestine
Descending colon
Duodenojejunal junction
Aorta
Ileum
Sigmoid colon
Sigmoid mesocolon
Anterior View

Sagittal section Mesentery and root of the mesentery



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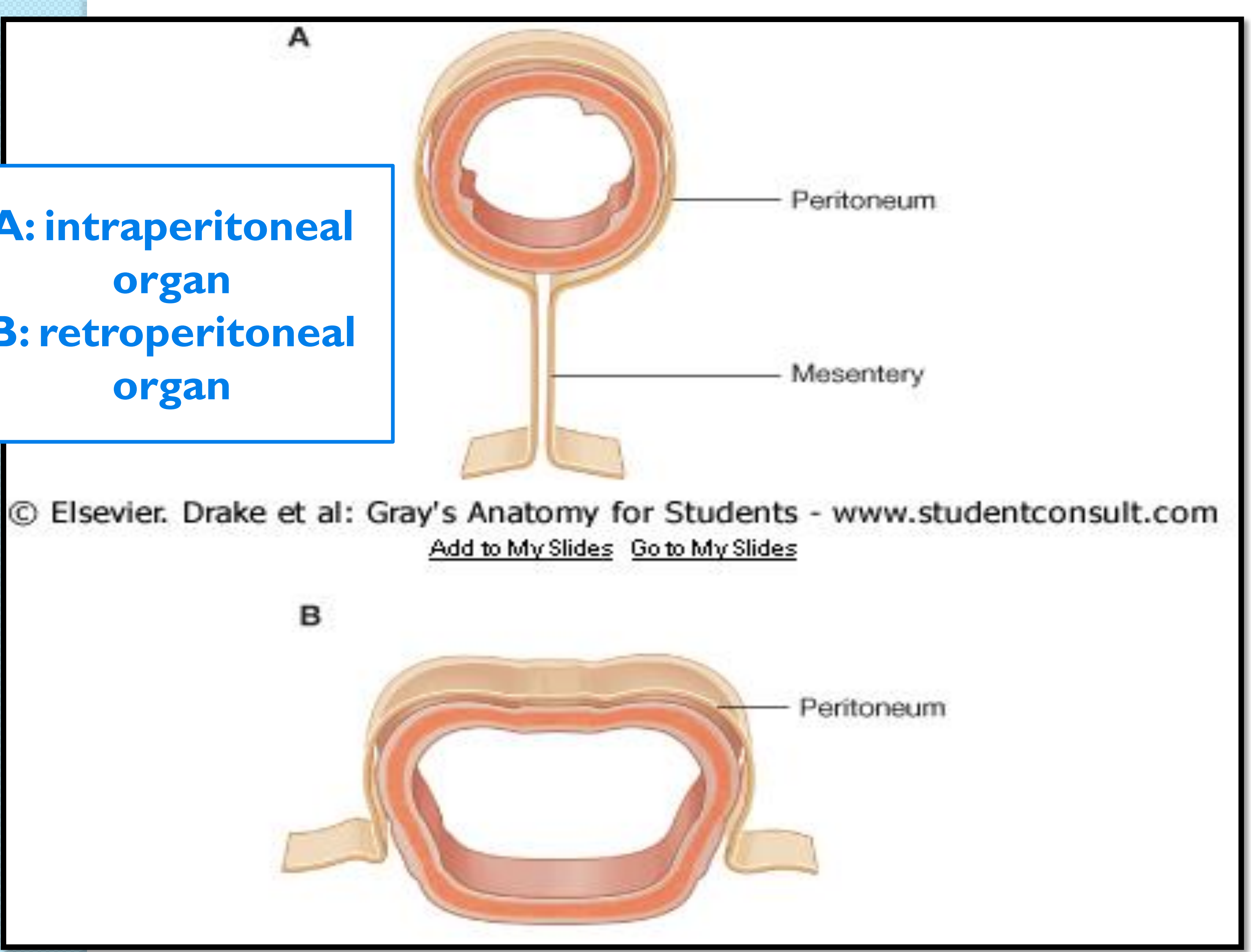
A: intraperitoneal organ

B: retroperitoneal organ



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- **Intraperitoneal organs:**
  - Are almost completely covered with visceral peritoneum (e.g., the stomach and spleen).
- **Extraperitoneal, retroperitoneal, and subperitoneal organs:**
  - Are only partially covered with peritoneum (e.g. the pancreas).

Peritoneum

- Layers.
- Mesenteries and arrangement of organs.
- **Peritoneal cavity.**
- **Innervation of the peritoneum.**
- **Ligaments of the peritoneum.**
- **Omenta.**
- **Greater and lesser sacs.**

The Peritoneal Cavity (1)

- **It is a potential space between the parietal and visceral layers of peritoneum.**
- **It contains a thin film of peritoneal fluid.**
- **Functions:**
  - **lubricates the peritoneal surfaces.**
  - **Defense: it contains leukocytes and antibodies.**

The Peritoneal Cavity (2)

- It is completely closed in males.
- In females: partially closed (opened to the exterior of the body through the uterine tubes, uterine cavity, and vagina).

Peritoneum

- Layers.
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Nerve Supply of the Peritoneum (1)

- The parietal peritoneum is sensitive to pain, temperature, touch, and pressure.
- **The parietal peritoneum lining the anterior abdominal wall:**
  - It is supplied by the lower six thoracic and first lumbar nerves.
- **Diaphragmatic peritoneum:**
  - The central part: is supplied by the phrenic nerves.
  - Peripherally: it is supplied by the lower six thoracic nerves.
- **The pelvic peritoneum:**
  - It is mainly supplied by the obturator nerve, a branch of the lumbar plexus.

Nerve Supply of the Peritoneum (2)

- **The visceral peritoneum is sensitive only to stretch and tearing and is not sensitive to touch, pressure, or temperature.**
- **It is supplied by autonomic afferent nerves that supply the viscera.**
- **Overdistention of a viscus leads to the sensation of pain.**

Peritoneum

- Layers.
- Mesenteries and arrangement of organs.
- Peritoneal cavity.
- Innervation of the peritoneum.
- **Ligaments of the peritoneum.**
- **Omenta.**
- **Greater and lesser sacs.**

Ligaments Of The Peritoneum

- **Median umbilical ligament (fold).**
- **Medial umbilical ligaments (folds).**
- **Lateral umbilical ligaments (folds).**
- **Falciform ligament.**
- **Ligamentum teres (round ligament of the liver).**

Ligaments Of The Peritoneum (I)

- **Median umbilical ligament (fold):**
  - The remnant of the urachus, which joined the apex of the fetal bladder to the umbilicus.
- **Medial umbilical ligaments (folds):**
  - The peritoneum covering the occluded parts of the umbilical arteries.
- **Lateral umbilical ligaments (folds):**
  - The peritoneum covering the inferior epigastric vessels).

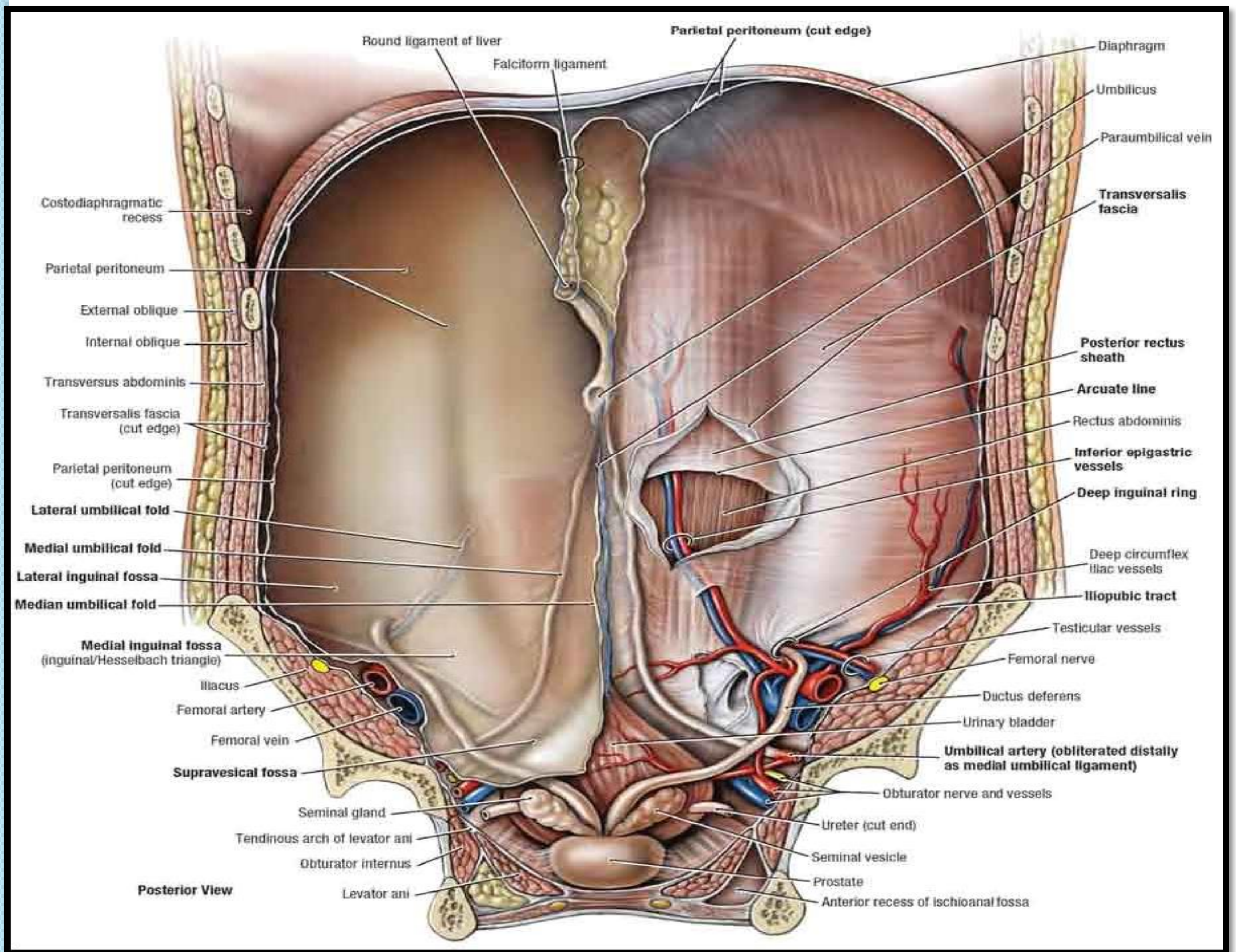
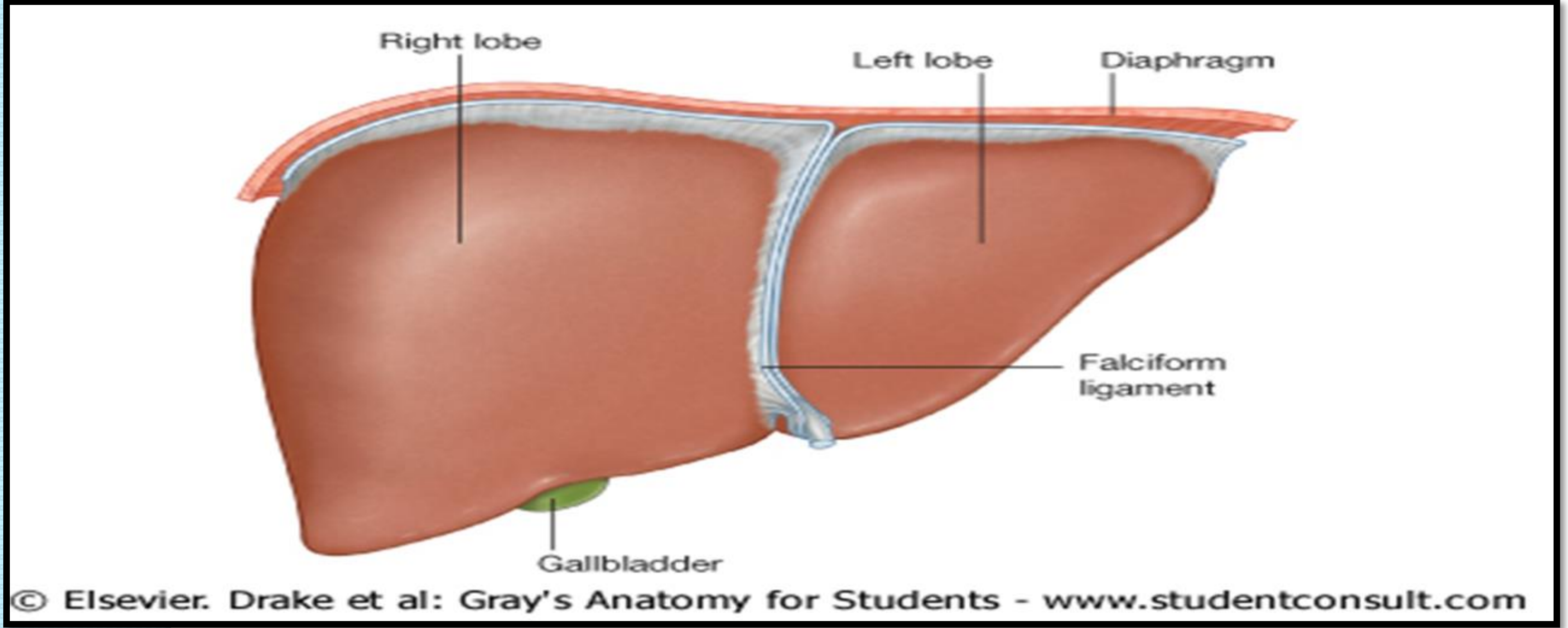


Image from: Agur, Anne M.R.; Dalley, Arthur F. Grant's Atlas of Human Anatomy. 12th Ed. Lippincott Williams & Wilkins; 2009.

Ligaments Of The Peritoneum (2)

- **Falciform ligament.**
- **Ligamentum teres (round ligament of the liver):**
  - **The fibrous remnant of the umbilical vein**

Falciform ligament and Ligamentum teres



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Peritoneum

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- Ligaments of the peritoneum.
- **Omenta.**
- **Greater and lesser sacs.**

Omenta

- Greater omentum.
- Lesser omentum.

Greater Omentum

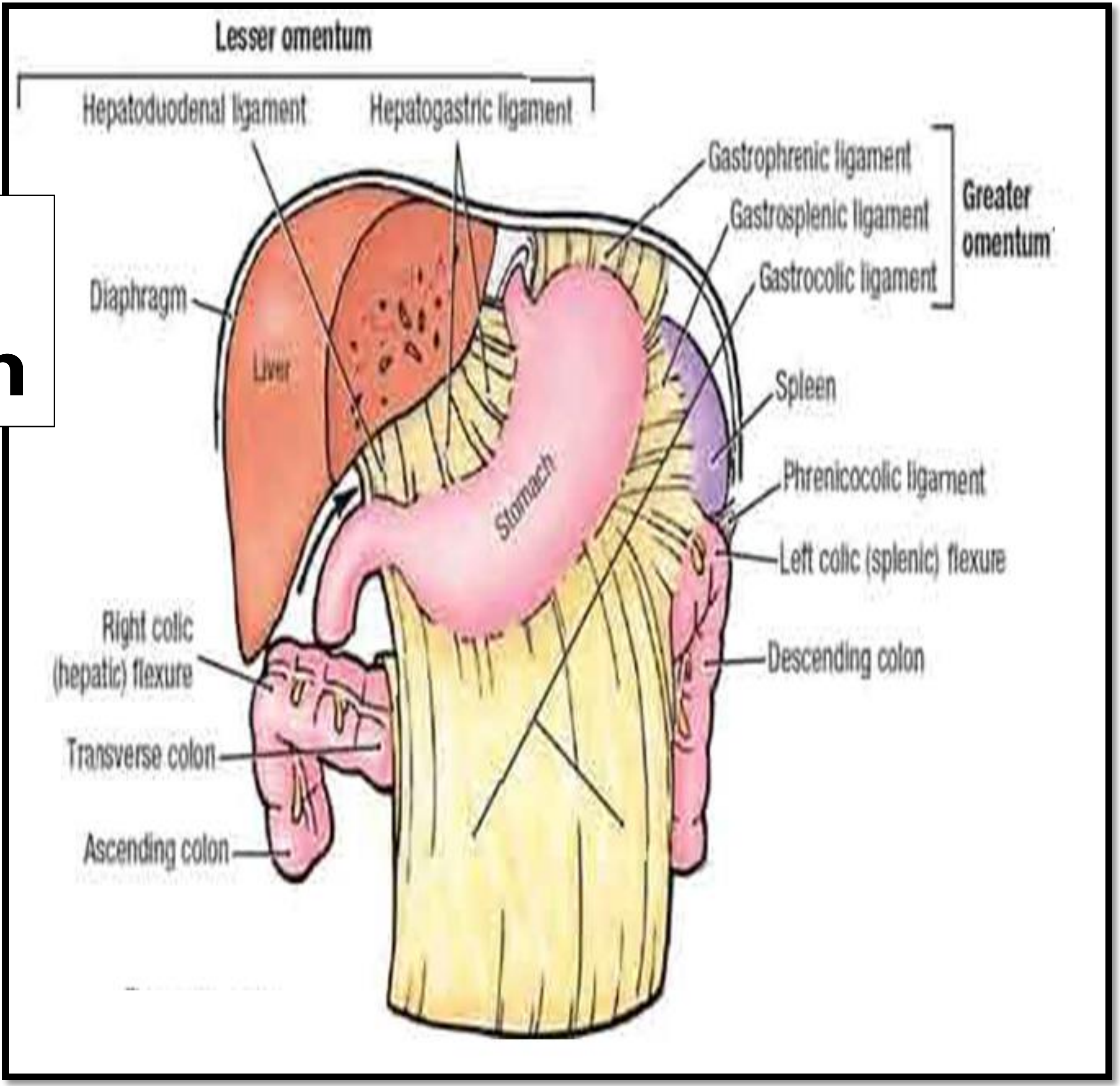

Image from: Agur, Anne M.R.; Dalley, Arthur F. Grant's Atlas of Human Anatomy. 12th Ed. Lippincott Williams & Wilkins; 2009.

Greater Omentum (reflected)

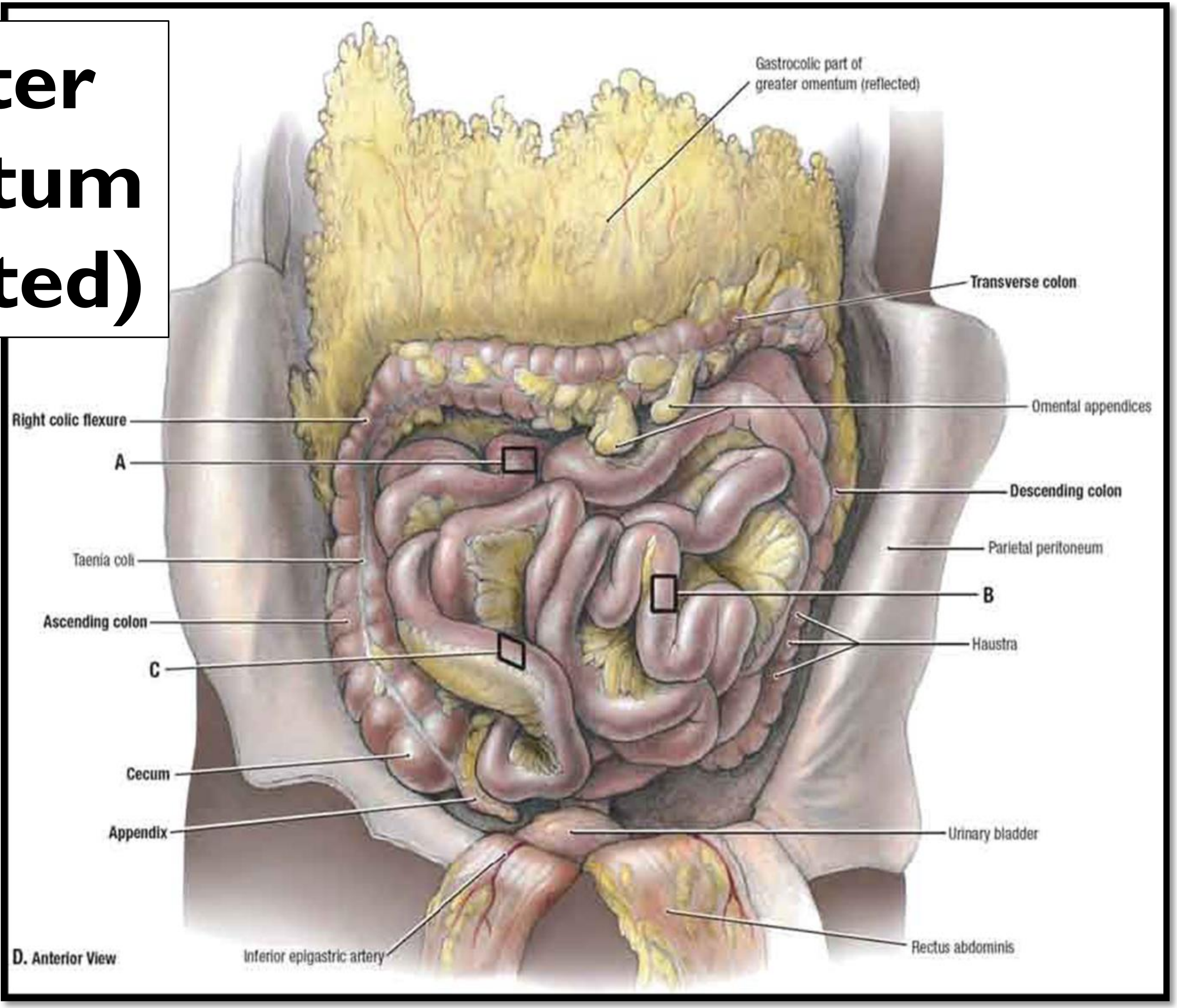

Image from: **Agur, Anne M.R.; Dalley, Arthur F. Grant's Atlas of Human Anatomy. 12th Ed. Lippincott Williams & Wilkins; 2009.**

Greater Omentum (cut to show part of the lesser sac)

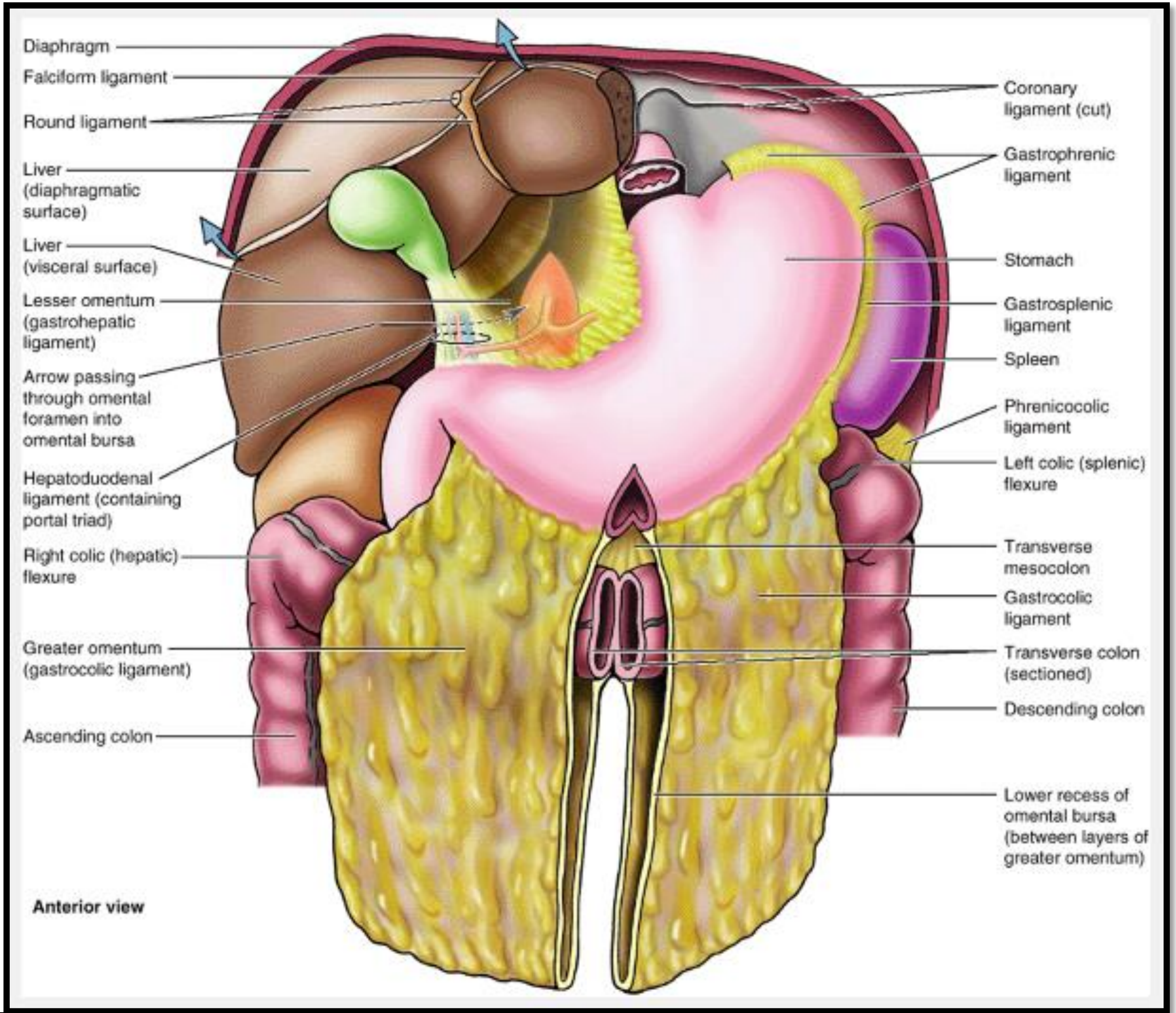
Diaphragm
Falciform ligament
Round ligament
Liver (diaphragmatic surface)
Liver (visceral surface)
Lesser omentum (gastrohepatic ligament)
Arrow passing through omental foramen into omental bursa
Hepatoduodenal ligament (containing portal triad)
Right colic (hepatic) flexure
Greater omentum (gastrocolic ligament)
Ascending colon
Anterior view
Coronary ligament (cut)
Gastrophrenic ligament
Stomach
Gastrosplenic ligament
Spleen
Phrenicocolic ligament
Left colic (splenic) flexure
Transverse mesocolon
Gastrocolic ligament
Transverse colon (sectioned)
Descending colon
Lower recess of omental bursa (between layers of greater omentum)

Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Epiploic foramen, posterior to the edge of the lesser omentum, leads to the lesser sac

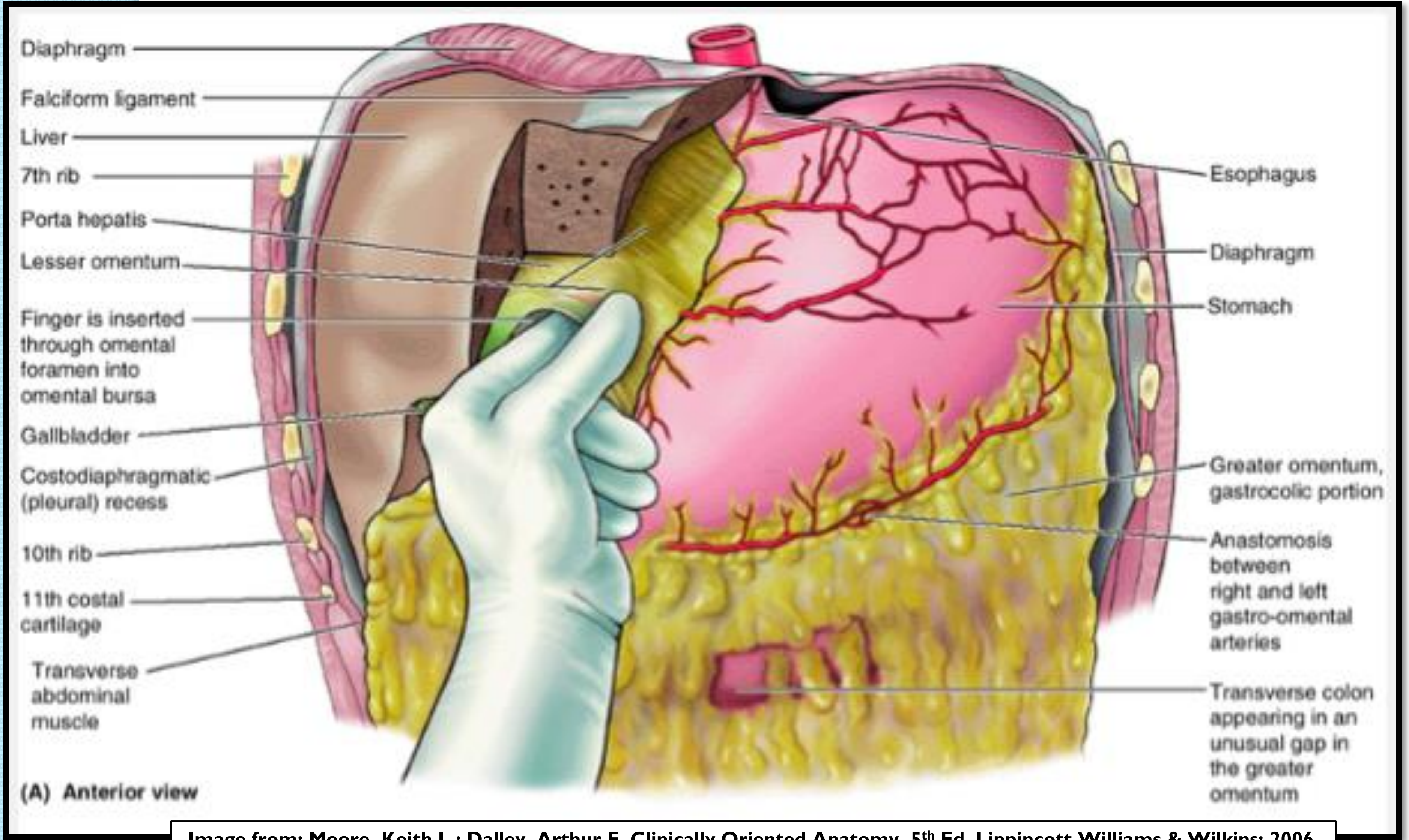
Diaphragm
Falciform ligament
Liver
7th rib
Porta hepatis
Lesser omentum
Finger is inserted through omental foramen into omental bursa
Gallbladder
Costodiaphragmatic (pleural) recess
10th rib
11th costal cartilage
Transverse abdominal muscle
(A) Anterior view
Esophagus
Diaphragm
Stomach
Greater omentum, gastrocolic portion
Anastomosis between right and left gastro-omental arteries
Transverse colon appearing in an unusual gap in the greater omentum

Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Embryology: development of the greater and lesser omenta

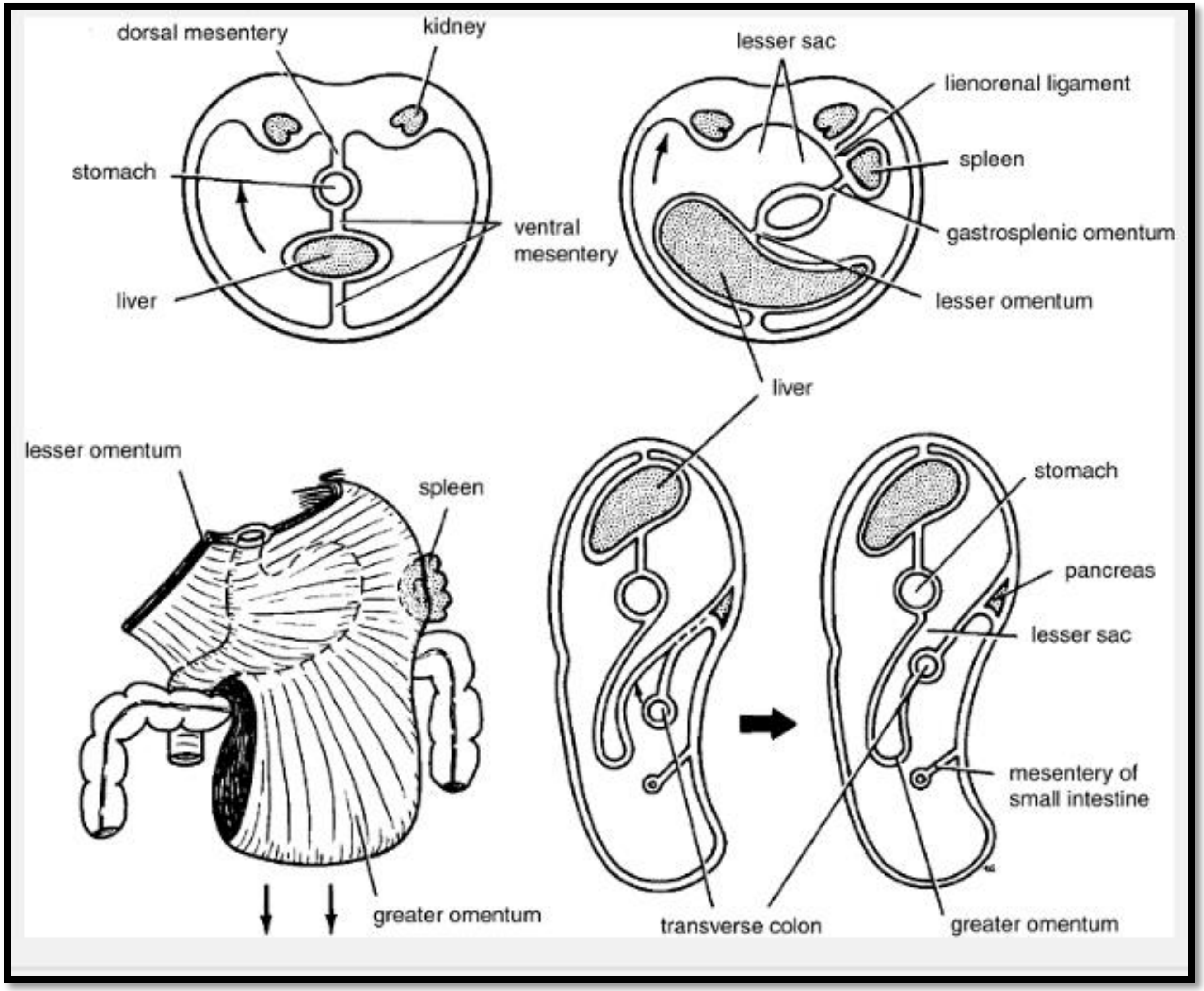

Image from: Richard S.Snell, Clinical Anatomy by Regions, 8th Ed. Lippincott Williams & Wilkins.

Peritoneum

- Layers.
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- Ligaments of the peritoneum.
- Omenta.
- **Greater and lesser sacs.**

The Lesser Sac: Boundaries

- **Anteriorly:**
    - Lesser omentum.
    - Stomach.
    - Greater omentum (anterior wall).
- **Posteriorly:**
    - Posterior abdominal wall (upper part).
    - Pancreas.
    - Transverse mesocolon.
    - Greater omentum (posterior wall).

The lesser sac Sagittal section

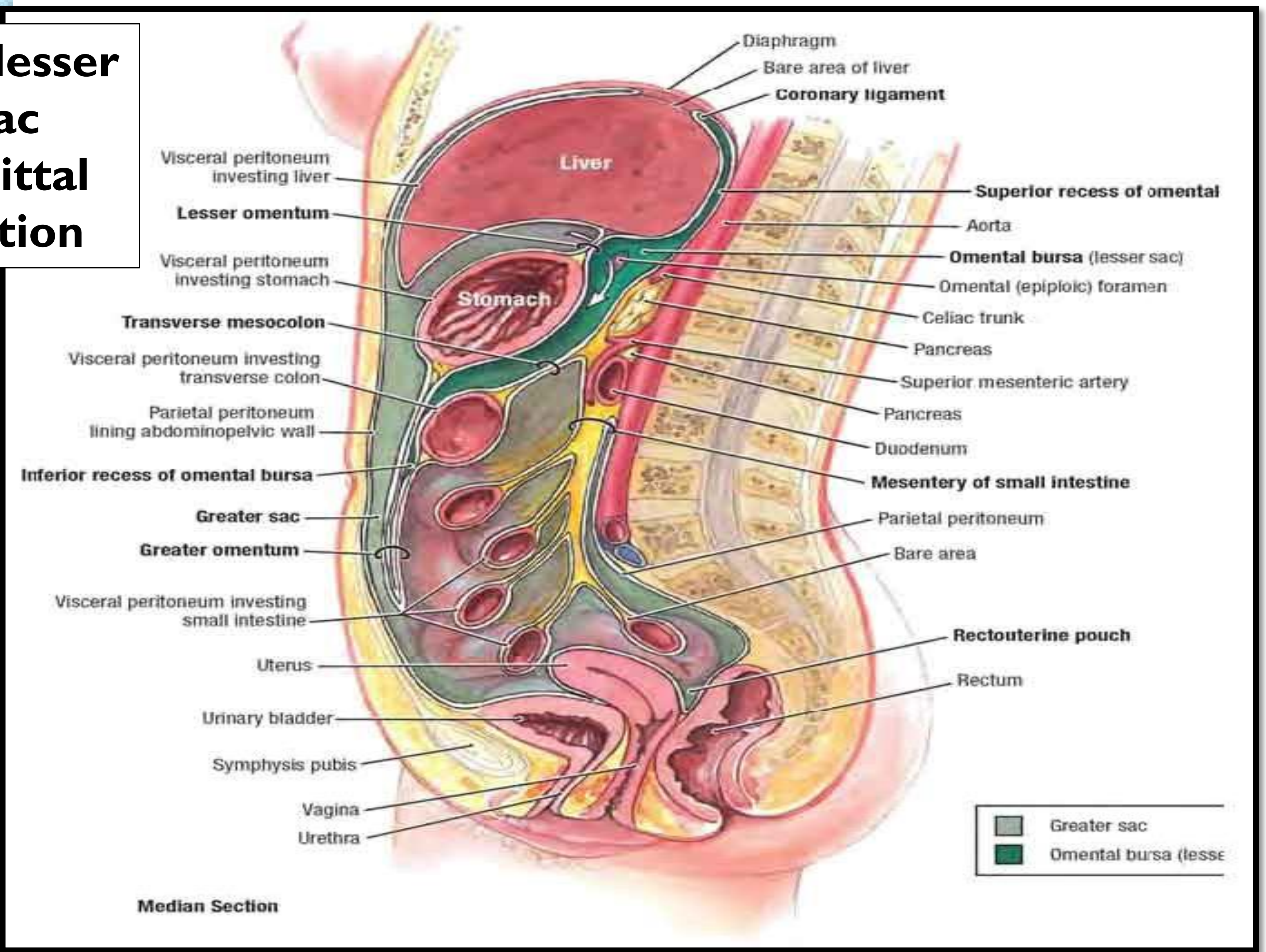

Diaphragm
Bare area of liver
Coronary ligament
Liver
Visceral peritoneum investing liver
Superior recess of omental
Aorta
Lesser omentum
Omental bursa (lesser sac)
Visceral peritoneum investing stomach
Omental (epiploic) foramen
Stomach
Celiac trunk
Transverse mesocolon
Pancreas
Visceral peritoneum investing transverse colon
Superior mesenteric artery
Pancreas
Parietal peritoneum lining abdominopelvic wall
Duodenum
Inferior recess of omental bursa
Mesentery of small intestine
Greater sac
Parietal peritoneum
Greater omentum
Bare area
Visceral peritoneum investing small intestine
Rectouterine pouch
Uterus
Rectum
Urinary bladder
Symphysis pubis
Vagina
Urethra
Greater sac
Omental bursa (lesse
Median Section

Image from: Agur, Anne M.R.; Dalley, Arthur F. Grant's Atlas of Human Anatomy. 12th Ed. Lippincott Williams & Wilkins; 2009.

The lesser sac Transverse section

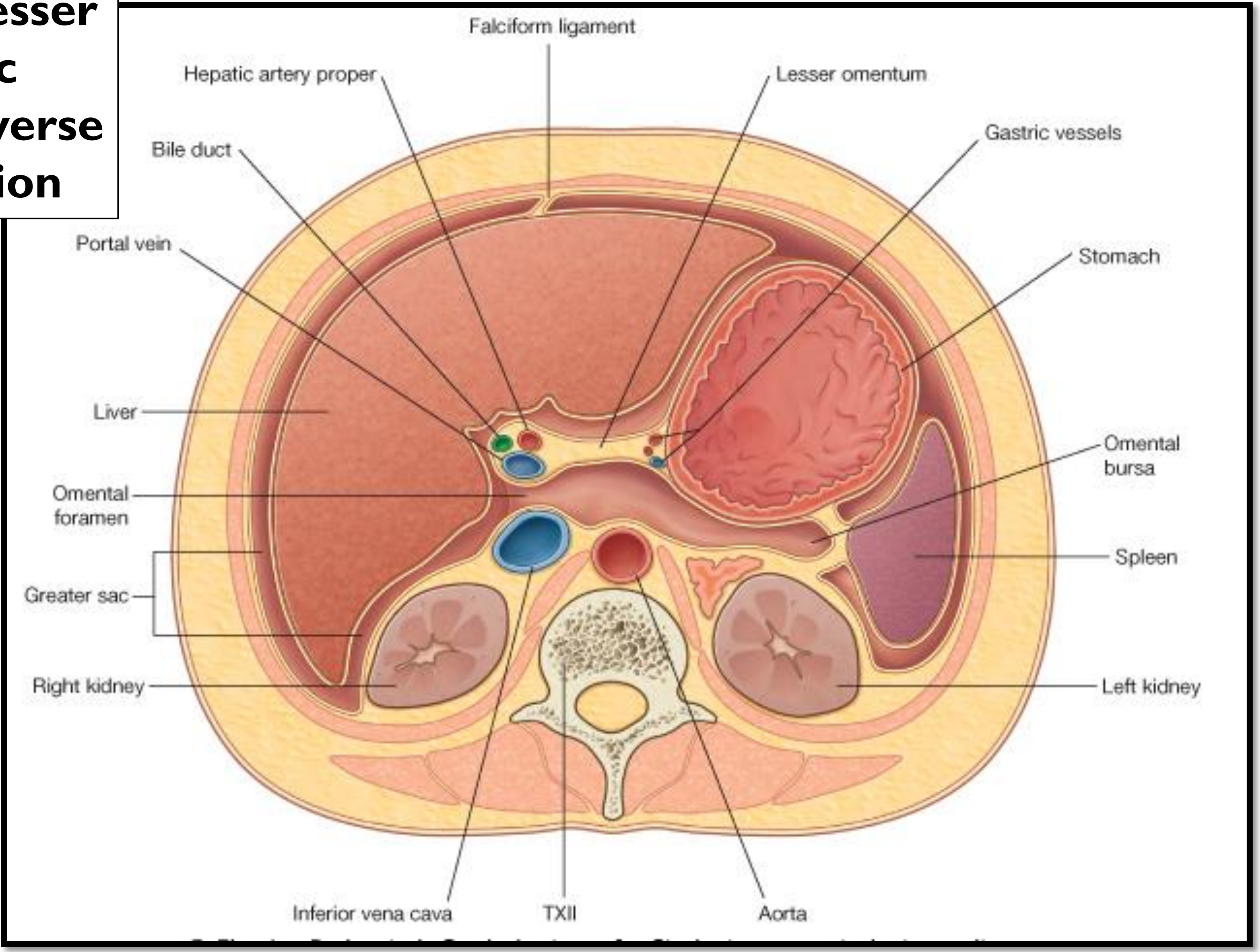
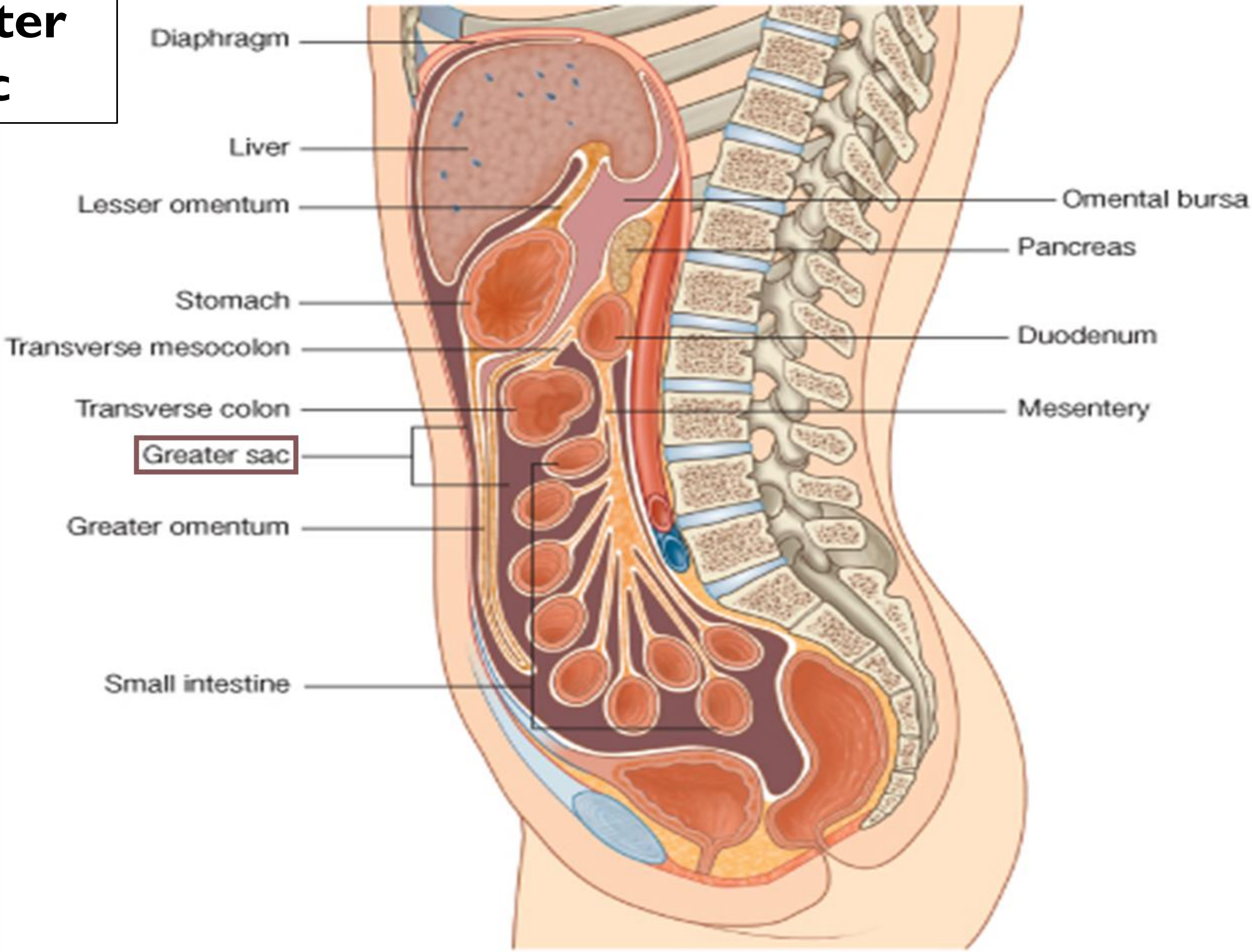


Image from: Richard L.Drake, Wayne Vogl,Adam W.M.Mitchell, GRAYS anatomy for students, Elsevier Inc. 2007

The Greater Sac



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Clinical Note: Ascites

- **Definition:**
  - **An excessive accumulation of peritoneal fluid within the peritoneal cavity.**
- **Causes: Secondary to:**
  - **Hepatic cirrhosis (portal venous congestion).**
  - **Congestive heart failure (systemic venous congestion).**

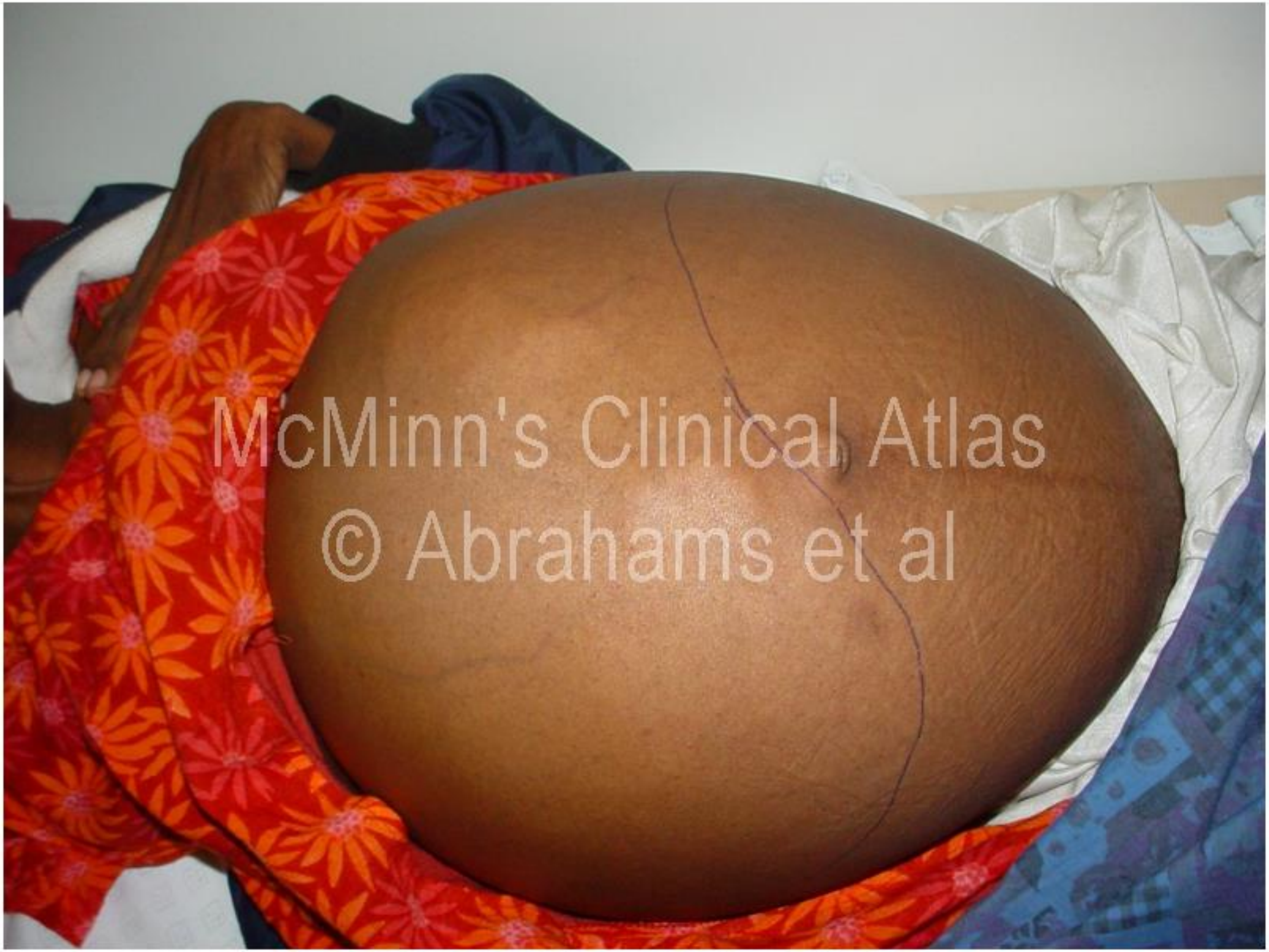
McMinn's Clinical Atlas
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Image from: Abraham's et al , McMinn clinical atlas.

Clinical Note: Paracentesis

- **Definition:**
  - Aspiration of fluids from the peritoneal cavity.
- **Benefits:**
  - Diagnostic and relieving.

Clinical Note: Peritonitis

- **Definition:**
  - Inflammation of the peritoneum.
- **Causes:**
  - Bacterial contamination during laparotomy.
  - Trauma.
  - Perforated ulcer.

Clinical Note: Peritoneal Adhesions

- **Definition of adhesions:**
  - **Abnormal attachments between the visceral peritoneum of adjacent viscera or between the visceral peritoneum of a viscus and the parietal peritoneum of the adjacent abdominal wall.**
- **Causes: Occur during the process of healing:**
  - **Trauma.**
  - **Infection.**
  - **Post-operative.**
- **Complications:**
  - **Limit the normal movements of the viscera (e.g. intestinal obstruction).**

Peritoneum

- Layers.
- Mesenteries and arrangement of organs.
- Peritoneal cavity.
- Innervation of the peritoneum.
- Ligaments of the peritoneum.
- Omenta.
- Greater and lesser sacs.

Lecture's map

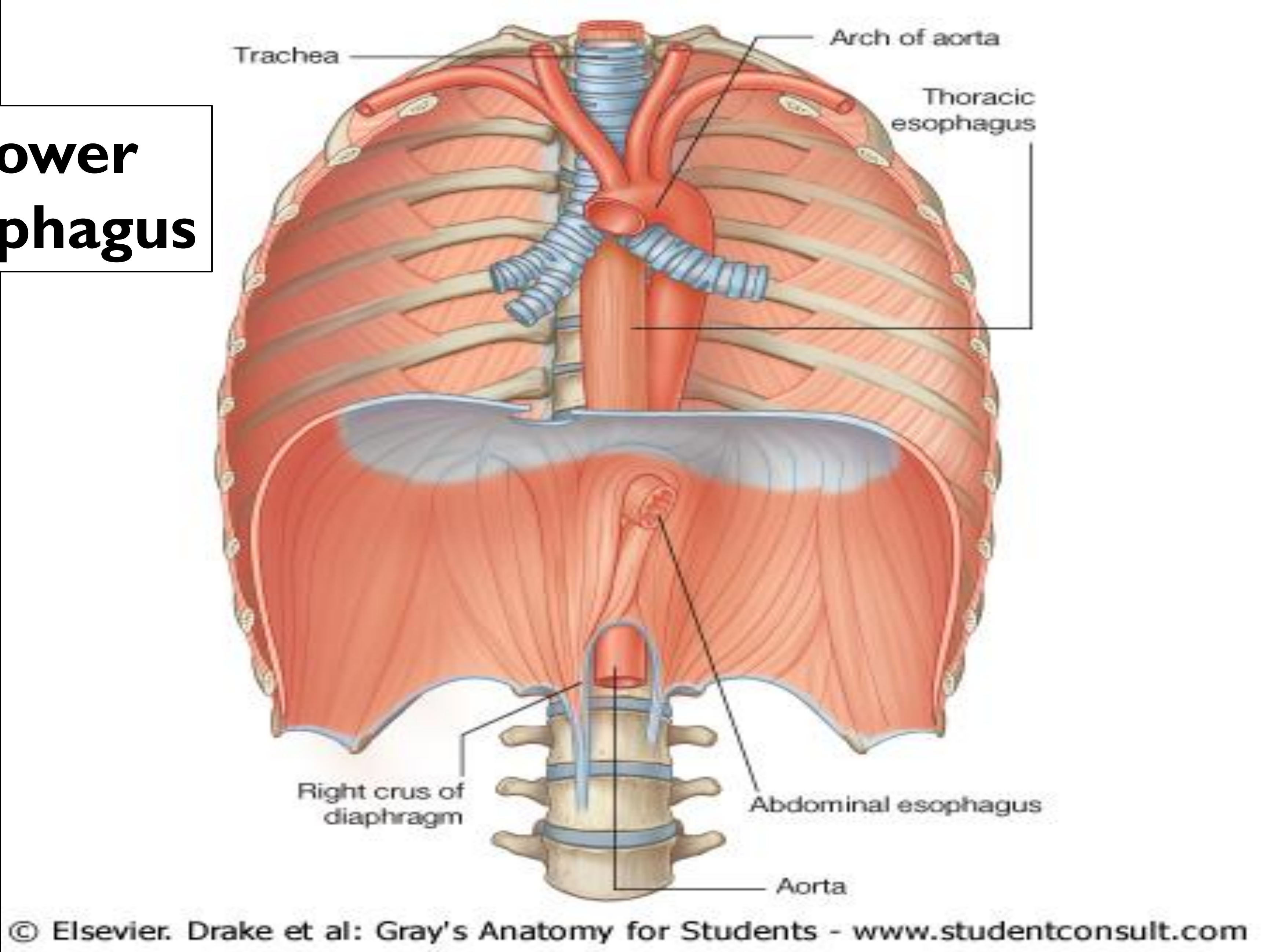
- Peritoneum.
- Lower esophagus.
- Stomach.
- Duodenum.

LOWER ESOPHAGUS

Lower Esophagus

- Emerging through the right crus of the diaphragm, at the level of vertebra TX.
- It passes from the esophageal hiatus to the cardial orifice of the stomach just left of the midline.

Lower esophagus



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Clinical Note: Esophageal Constrictions (1)

- Awareness of these constrictions is important when passing endoscope through the esophagus into the stomach and when viewing radiographs of esophagus:
    - Cervical constriction.
    - Thoracic (broncho-aortic) constriction.
    - Diaphragmatic constriction.

Gastroesophageal Sphincter

- **The circular layer of smooth muscle in this region serves as a physiologic sphincter.**
- **The closure of the sphincter is under vagal control.**
- **Augmented by the hormone gastrin.**
- **Reduced in response to secretin, cholecystokinin, and glucagon.**

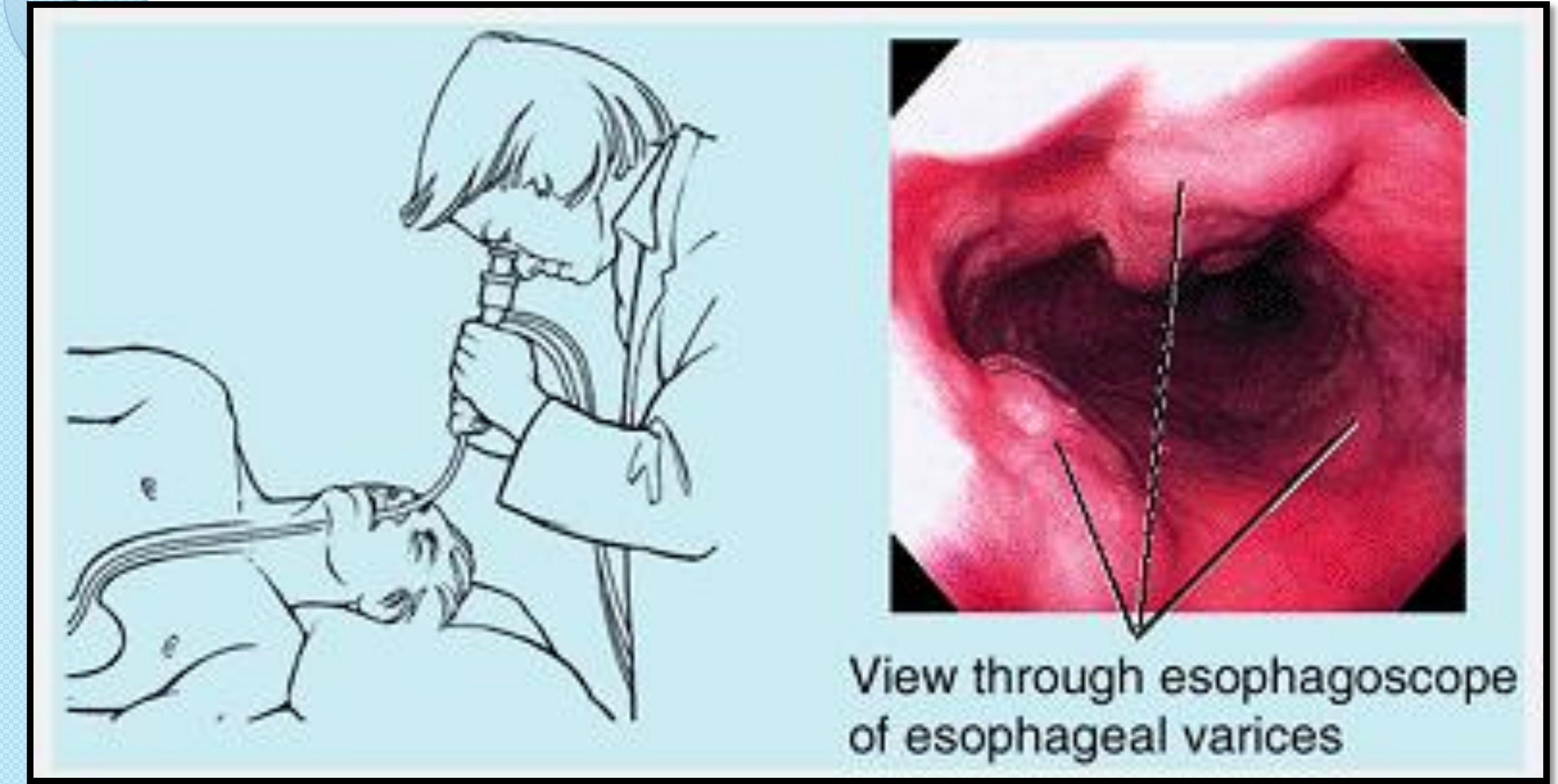
Lower Esophagus

- **Arteries:**
  - Branches from the left gastric artery
- **Veins:**
  - Drain into the left gastric vein, a tributary of the portal vein.
- **Lymph Drainage:**
  - The lymph vessels follow the arteries into the left gastric nodes.
- **Nerve Supply:**
  - The anterior and posterior gastric nerves (vagi) and sympathetic branches of the thoracic part of the sympathetic trunk.

Clinical Note: Esophageal Varices

- **Definition:**
  - Enlarged submucosal veins of the lower sophagus.
- **Causes:**
  - Portal hypertension: back pressure to the veins in the lower esophagus (an area o porto-systemic anastomosis)
- **Complications:**
  - May rupture and cause severe hemorrhage.

Esophageal Varices



View through esophagoscope of esophageal varices

Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Lecture's map

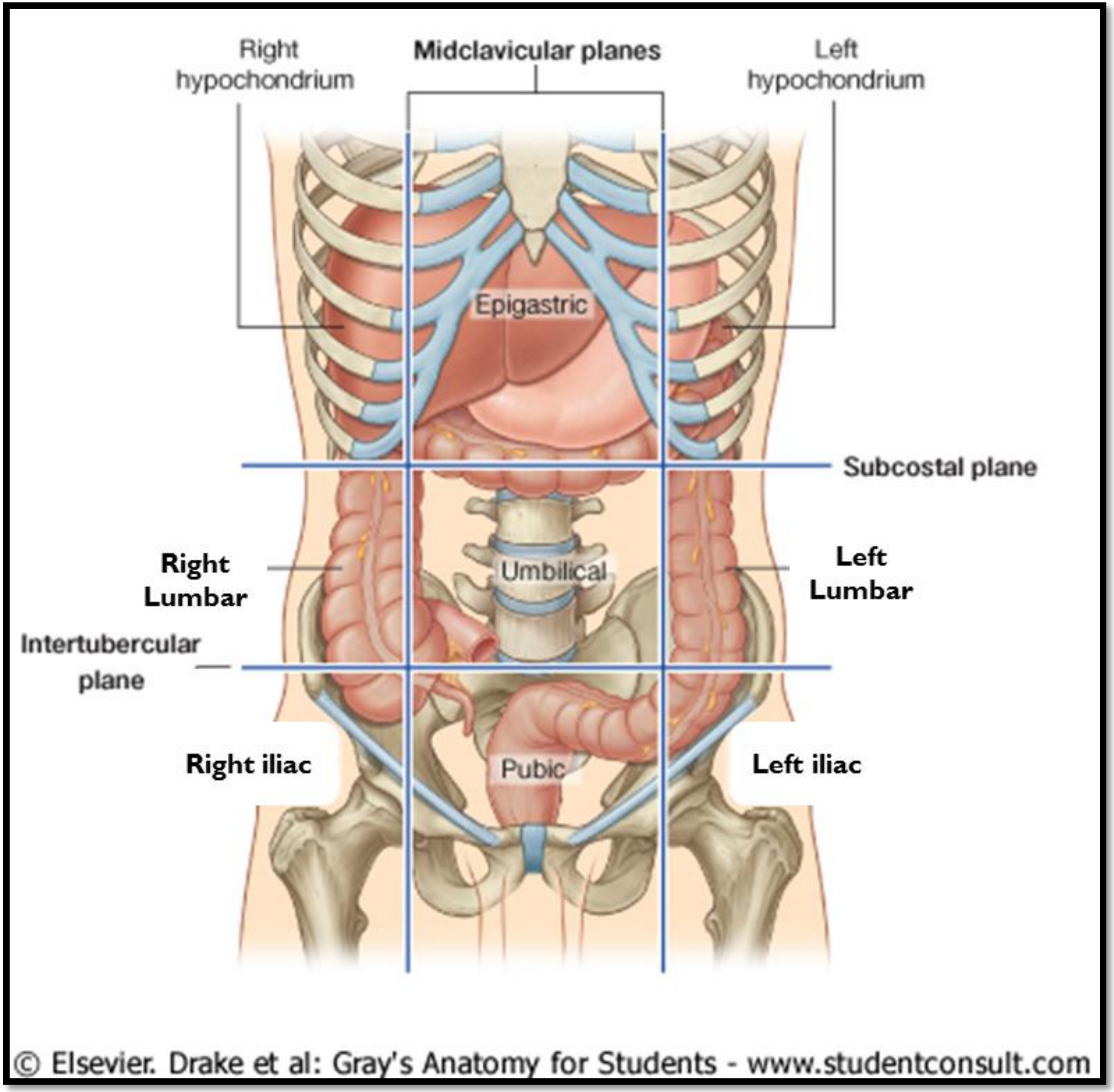
- Peritoneum.
- Lower esophagus.
- **Stomach.**
- **Duodenum.**

STOMACH

Stomach

- Location.
- Shape and parts.
- Structure.
- Relations.
- Blood supply.

Location



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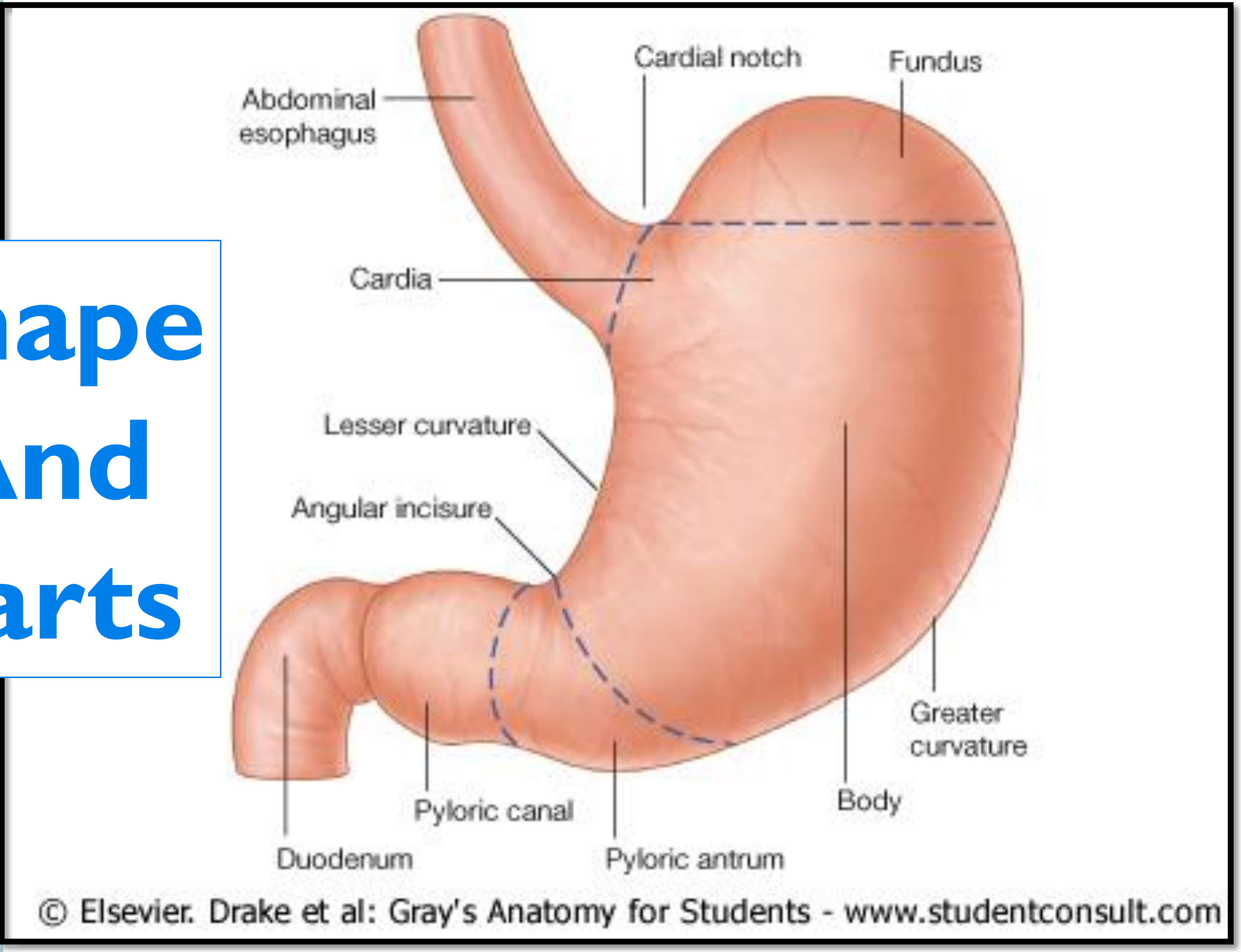
Shape And Parts



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Structure: Internal surface

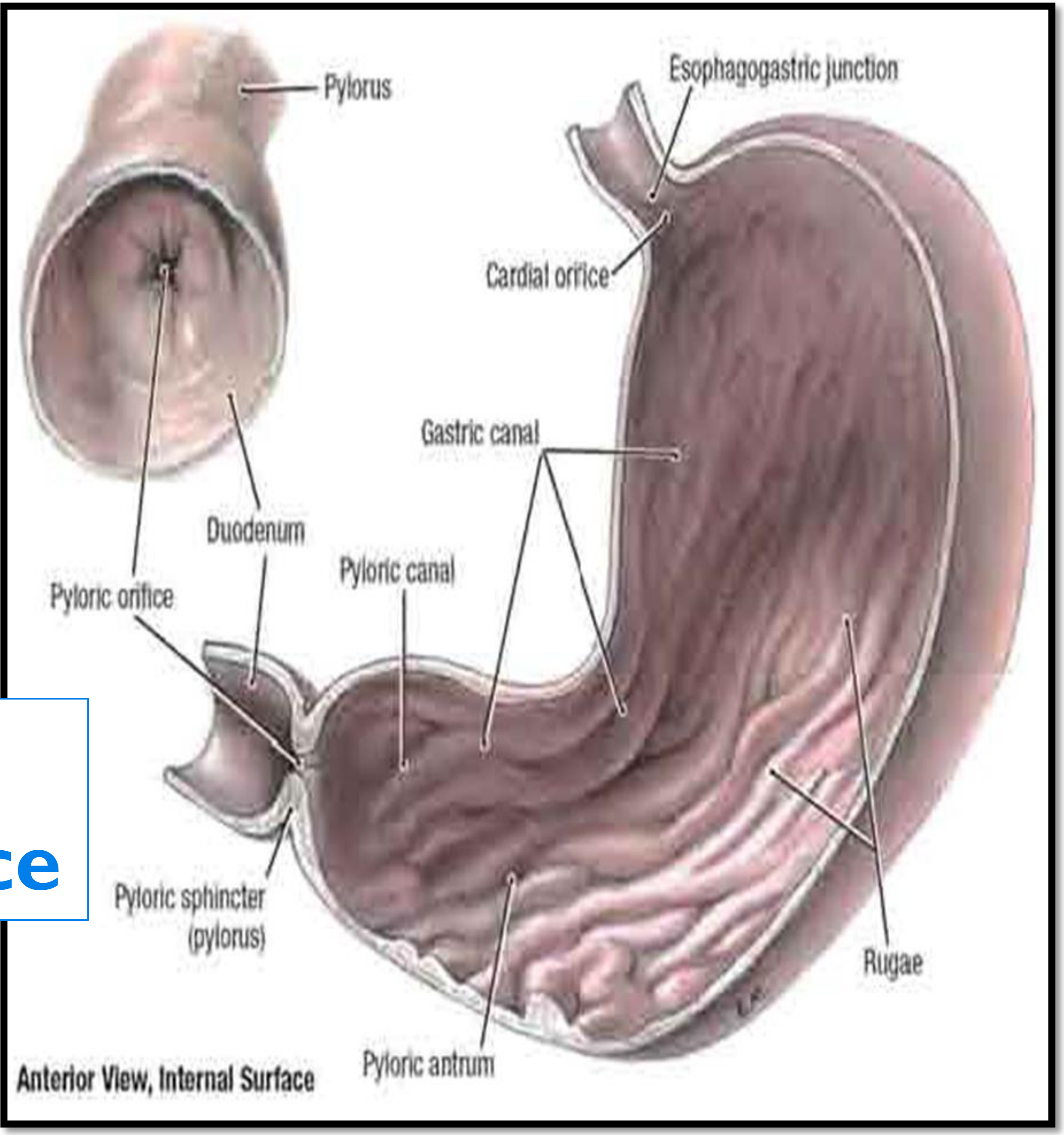
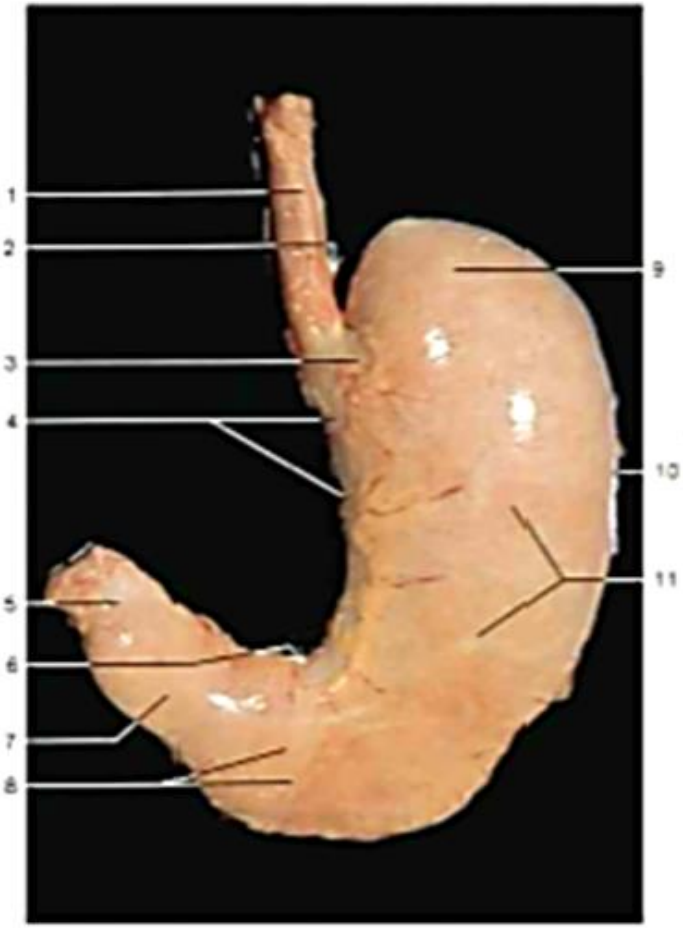
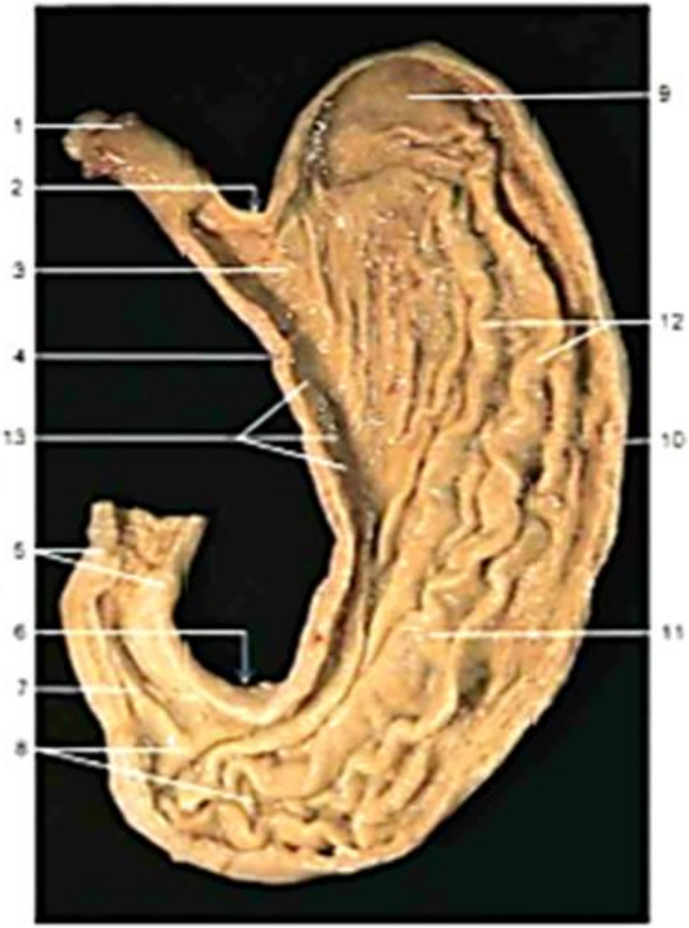


Image from: Agur, Anne M.R.; Dalley, Arthur F. Grant's Atlas of Human Anatomy. 12th Ed. Lippincott Williams & Wilkins; 2009.

1 Esophagus
2 Cardial notch
3 Cardial part of stomach
4 Lesser curvature of stomach
5 Pyloric sphincter
6 Angular notch (incisura angularis)
7 Pyloric canal
8 Pyloric antrum
9 Fundus of stomach
10 Greater curvature of stomach
11 Body of stomach
12 Folds of mucous membrane (gastric rugae)
13 Gastric canal



Stomach (ventral aspect).



Mucosa of posterior wall of stomach (ventral aspect).

Image from: Johannes W.Rohen; Chihiro Yokochi; Elke Lütjen-Drecoll. Color atlas of anatomy. 7th edition. Lippincott Williams & Wilkins 2011

Structure: Layers of the wall

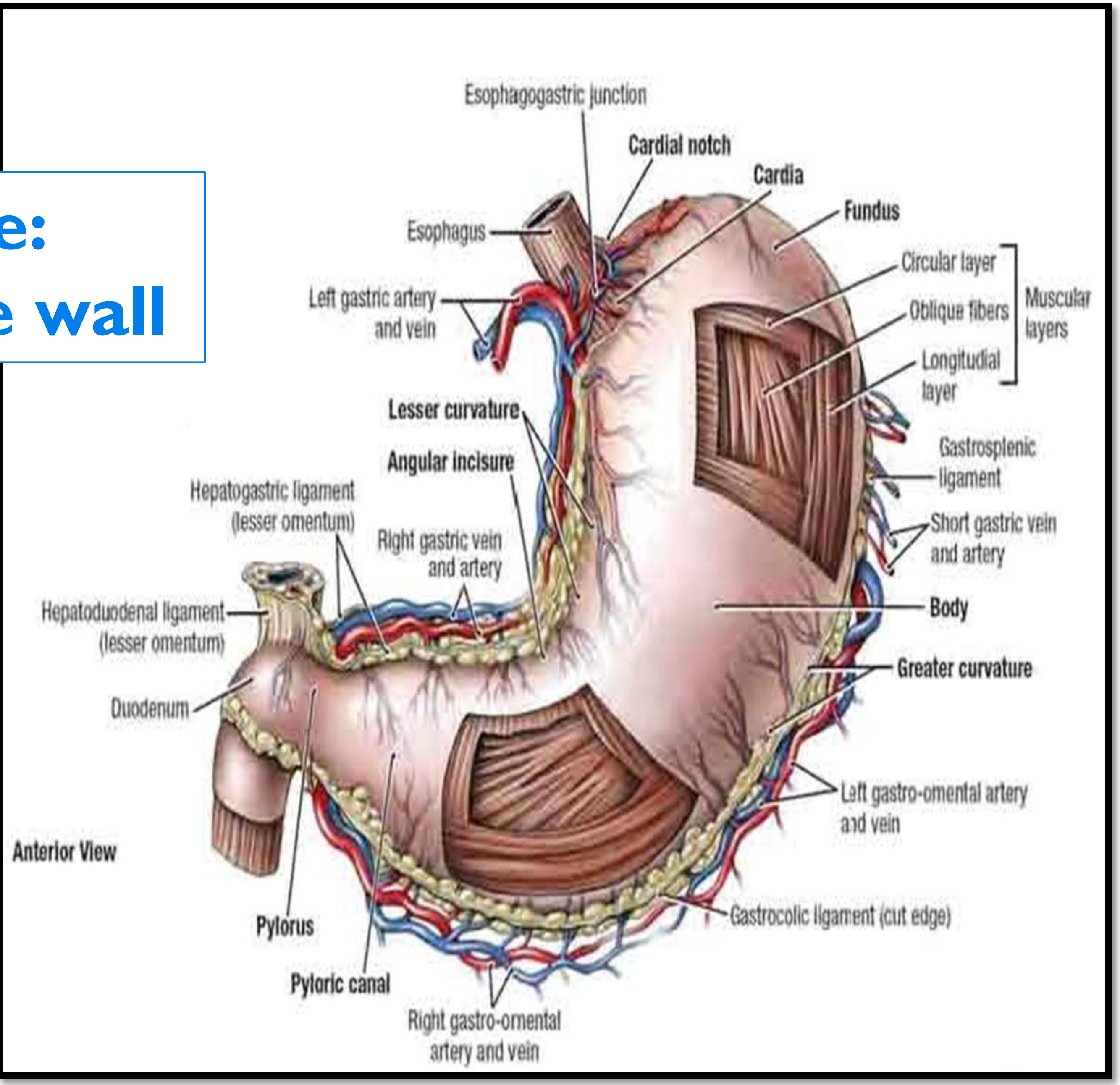
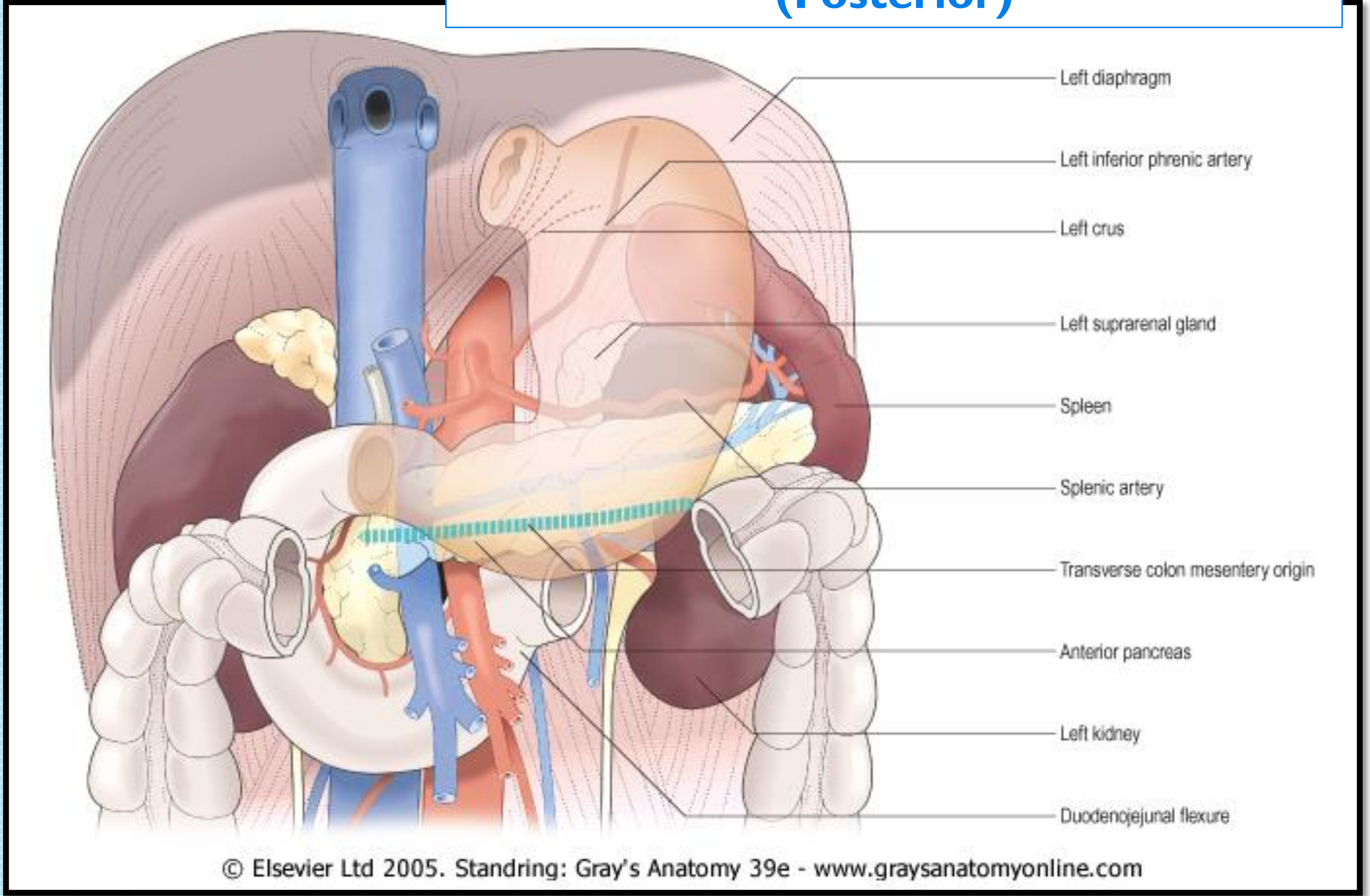

Esophagogastric junction
Cardial notch
Cardia
Fundus
Esophagus
Circular layer
Oblique fibers
Longitudial layer
Muscular layers
Left gastric artery and vein
Lesser curvature
Angular incisure
Gastrosplenic ligament
Hepatogastric ligament (lesser omentum)
Right gastric vein and artery
Short gastric vein and artery
Body
Hepatoduodenal ligament (lesser omentum)
Greater curvature
Duodenum
Left gastro-omental artery and vein
Anterior View
Gastrocolic ligament (cut edge)
Pylorus
Pyloric canal
Right gastro-omental artery and vein

Image from: Agur, Anne M.R.; Dalley, Arthur F. Grant's Atlas of Human Anatomy. 12th Ed. Lippincott Williams & Wilkins; 2009.

Relations of the stomach (Posterior)



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Blood supply

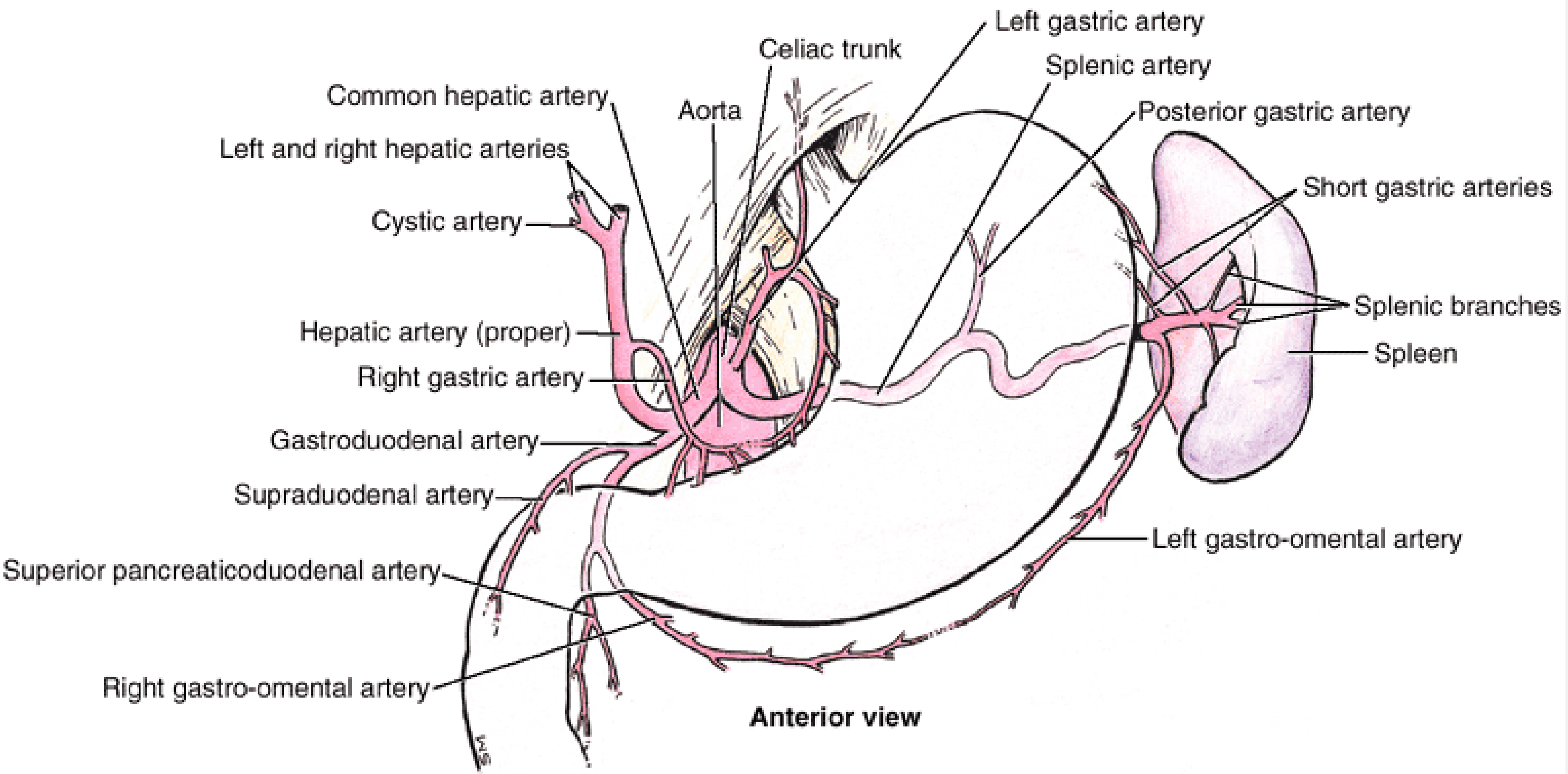


Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Artery	Origin	Distribution
Left gastric	Celiac trunk	Lower part of esophagus Lesser curvature of stomach
Splenic		Body of pancreas, spleen, and greater curvature and posterior stomach body
Posterior gastric	Splenic artery	Posterior wall and fundus of stomach
left gastroepiploic		Left portion of greater curvature of stomach
Short gastric		Fundus of stomach
Hepatic	Celiac trunk	Liver, gallbladder and biliary ducts, stomach, duodenum, pancreas and respective lobes of liver
Cystic	Right hepatic artery	Gallbladder and cystic duct
Right gastric	Hepatic artery	Right portion of lesser curvature of stomach
Gastroduodenal		Stomach, pancreas, first part of duodenum, and distal part of bile duct
Right gastroepiploic	Gastroduodenal artery	Right portion of greater curvature of stomach
Superior pancreaticoduodenal	Gastroduodenal artery	Proximal portion of duodenum and superior part of head of pancreas
Inferior pancreaticoduodenal	Superior mesenteric artery	Distal portion of duodenum and head of pancreas

Venous drainage

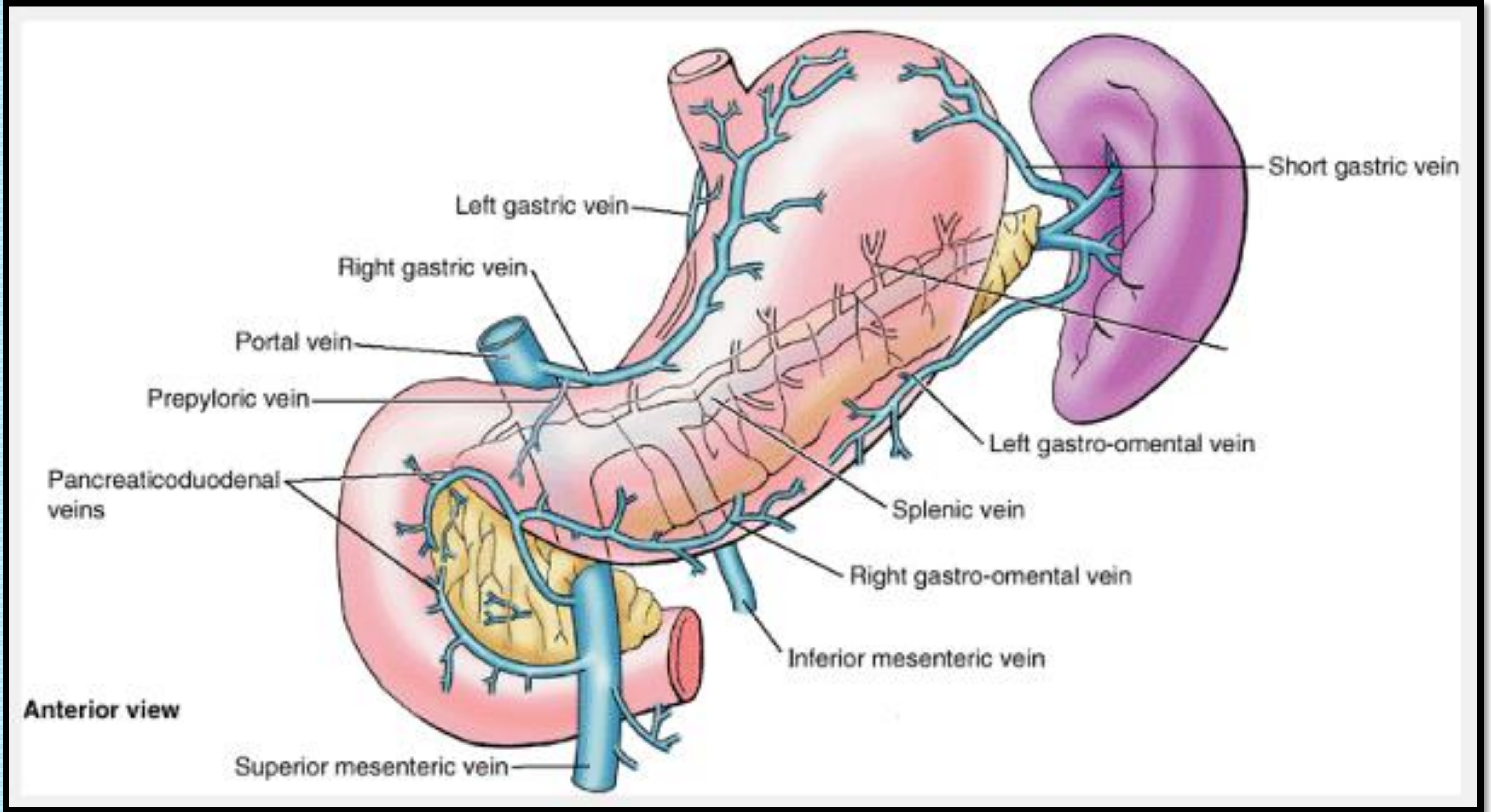
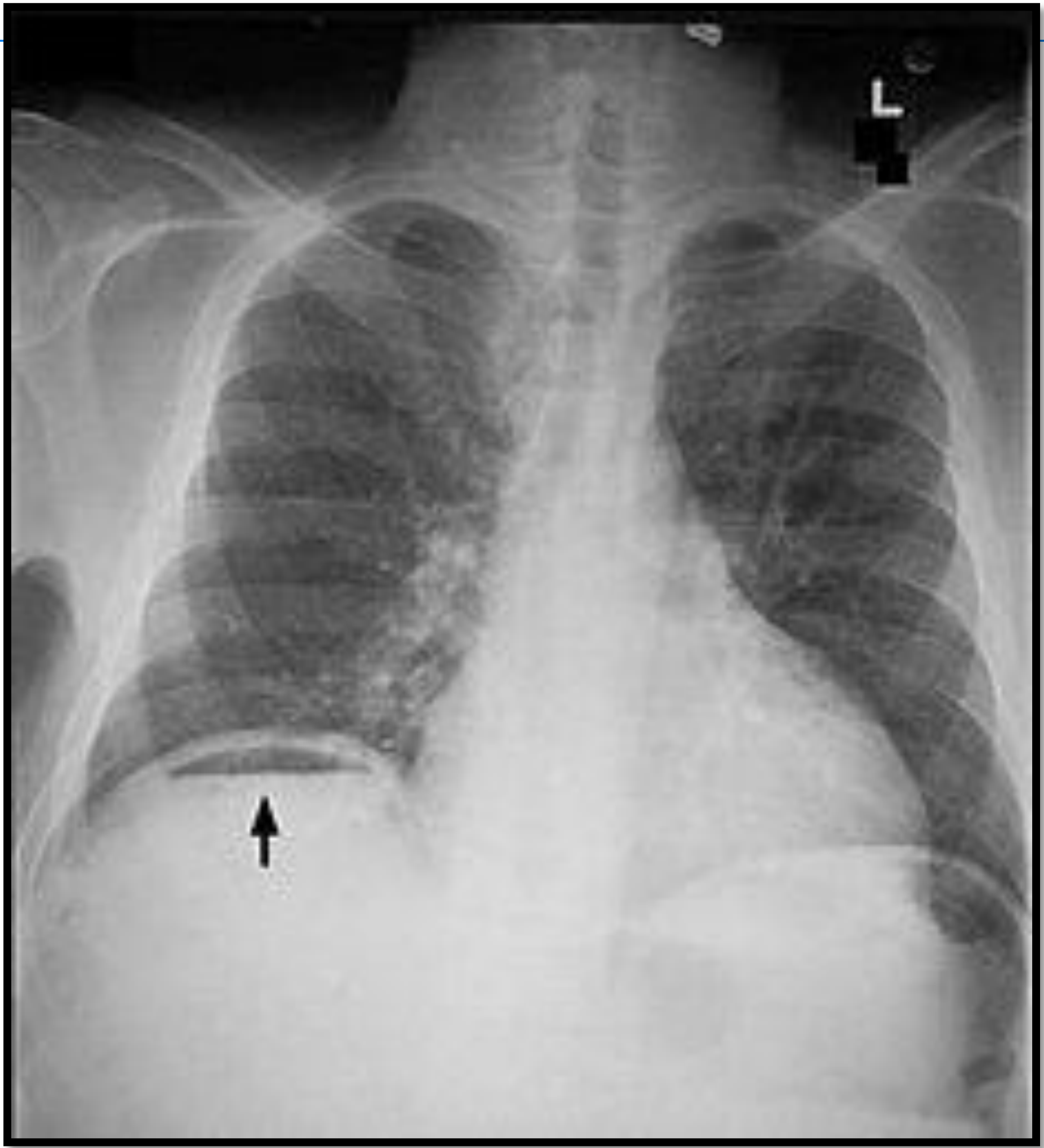


Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Clinical Note: Gastric Ulcers

- **Definition of ulcer:**
  - Discontinuity in the epithelial lining.
- **Causes of gastric ulcer:**
  - Helicobacter pylori (H. pylori).
  - Severe chronic anxiety or stress.
- **Complications:**
  - Bleeding.

Radiology: Air under the diaphragm



Lecture's map

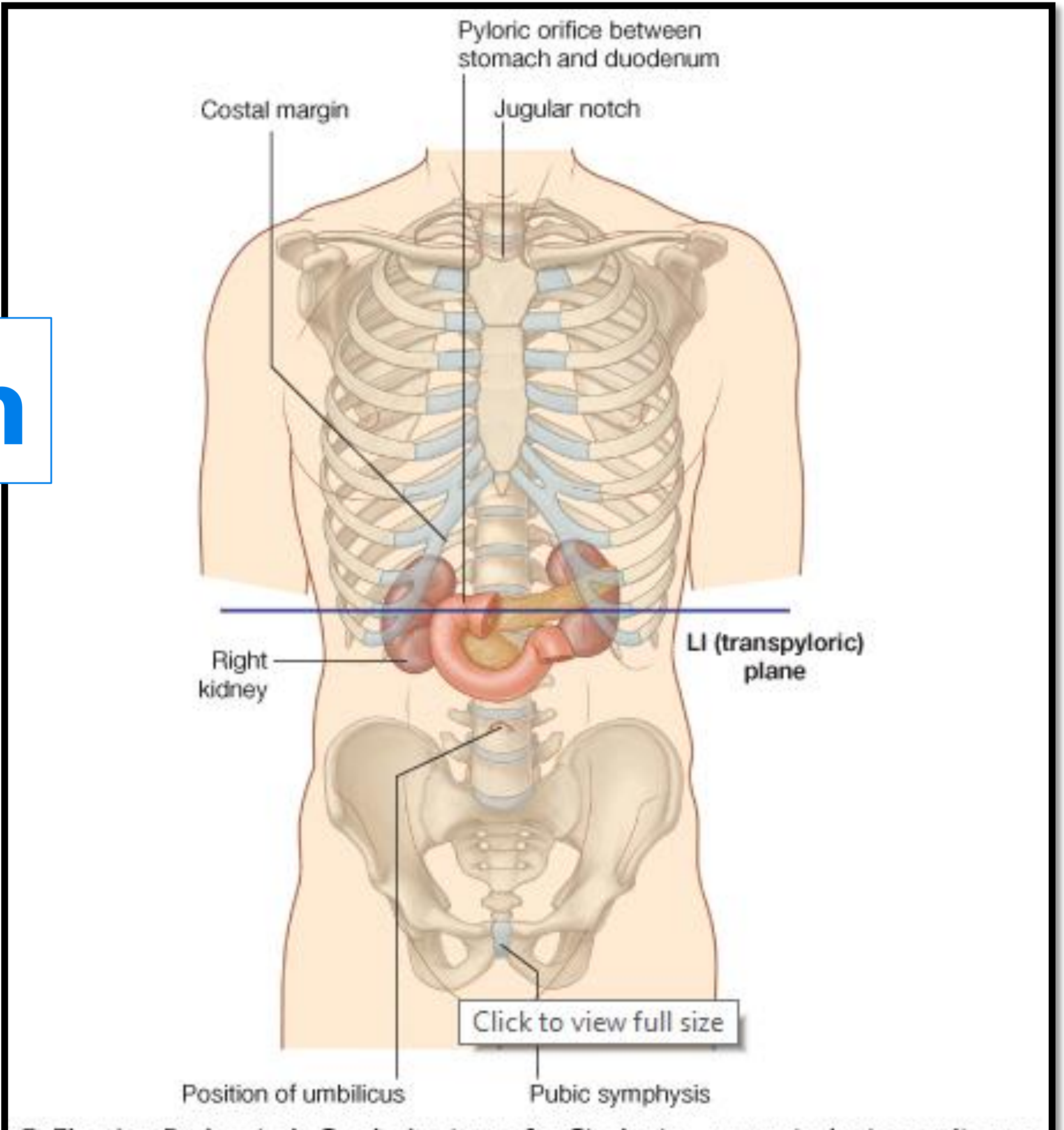
- Peritoneum.
- Lower esophagus.
- Stomach.
- **Duodenum.**

DUODENUM

Duodenum

- Location.
- Shape and parts.
- Relations.
- Blood supply.
- Lymphatics.
- Innervation.

Location



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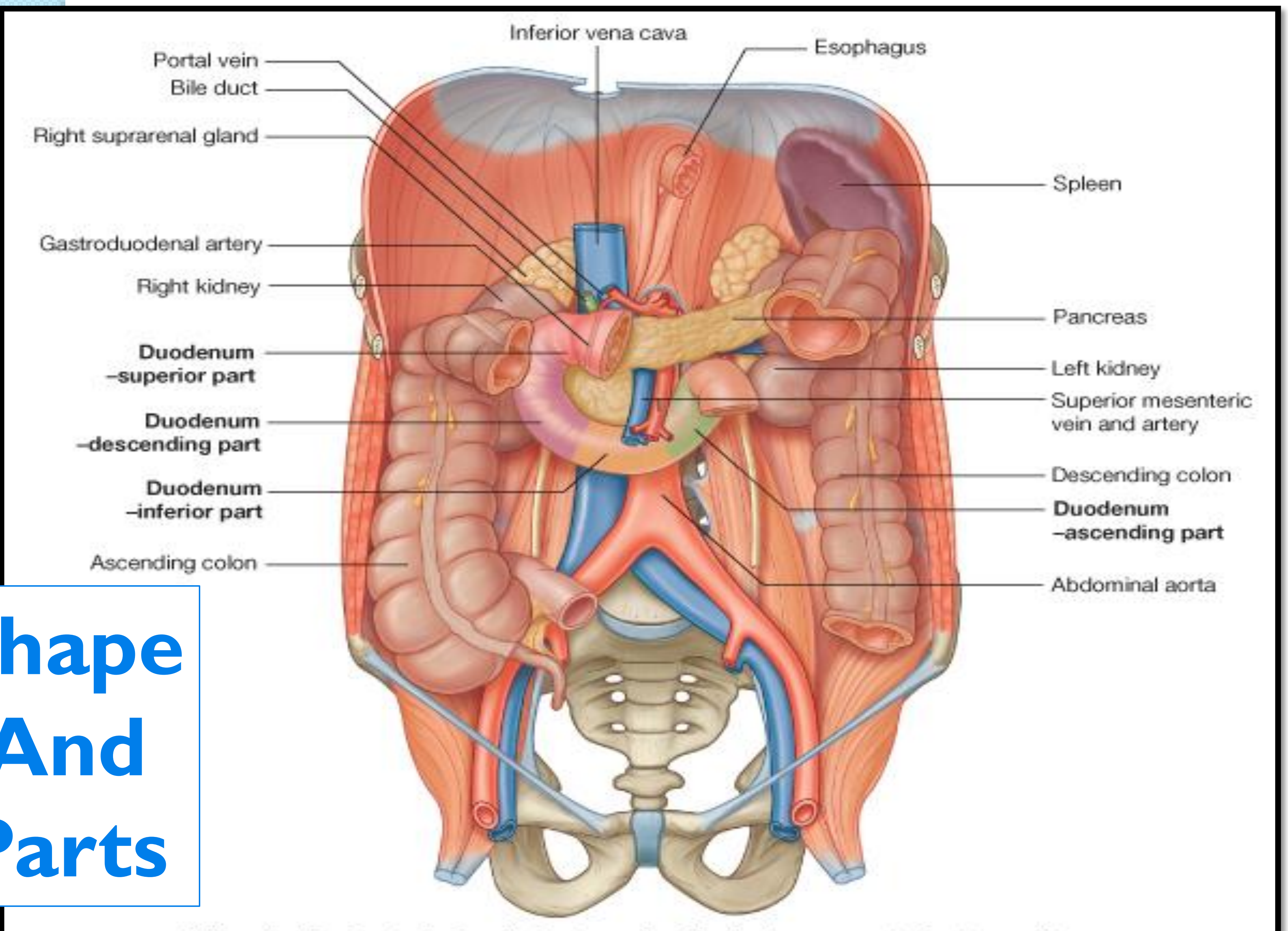
Duodenum

- **It Is The First, Shortest, Widest And Most Fixed Part Of The Small Intestine.**

Shape And Parts



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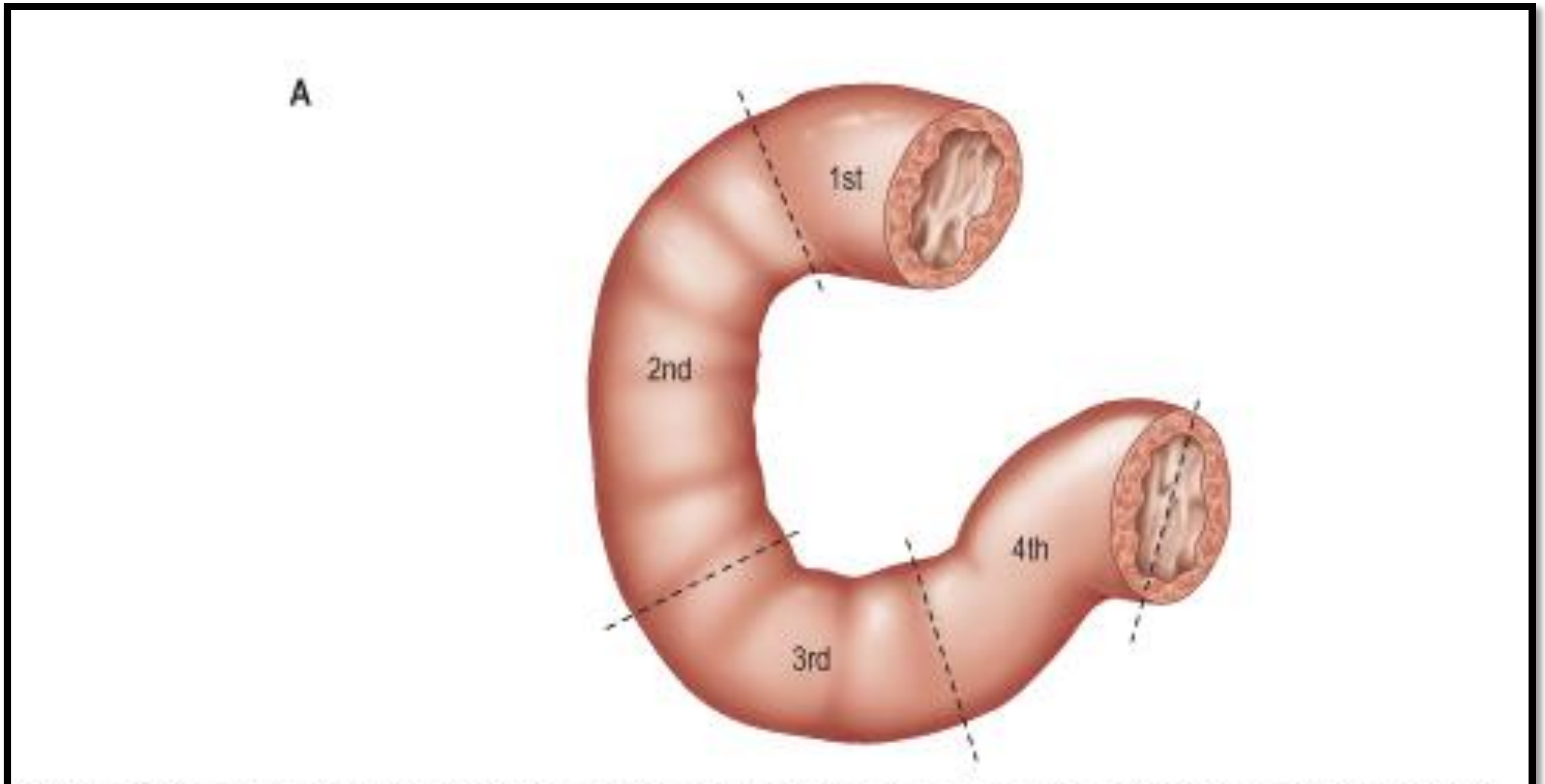
Parts Of The Duodenum



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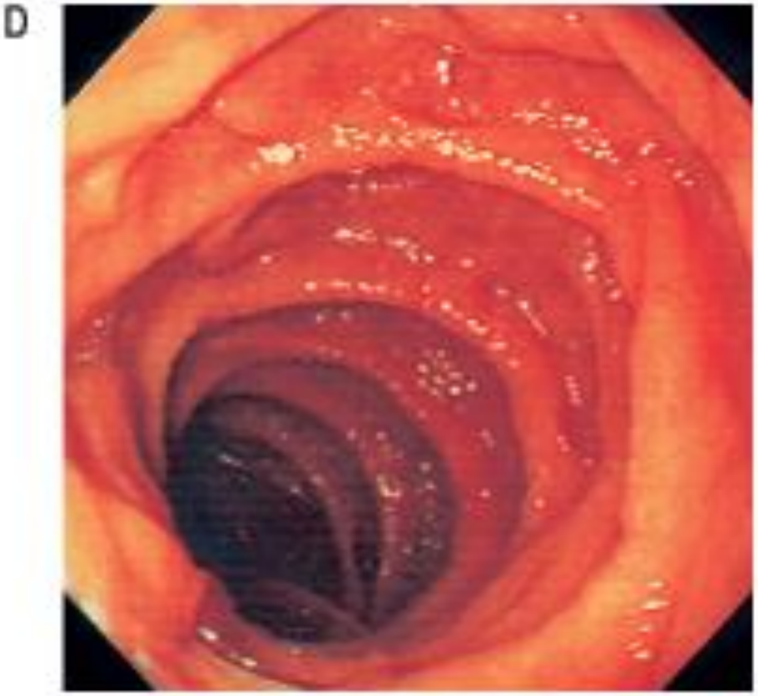
Clinical Note: The Endoscopic Appearances Of The Duodenum (3rd Part As An Example)



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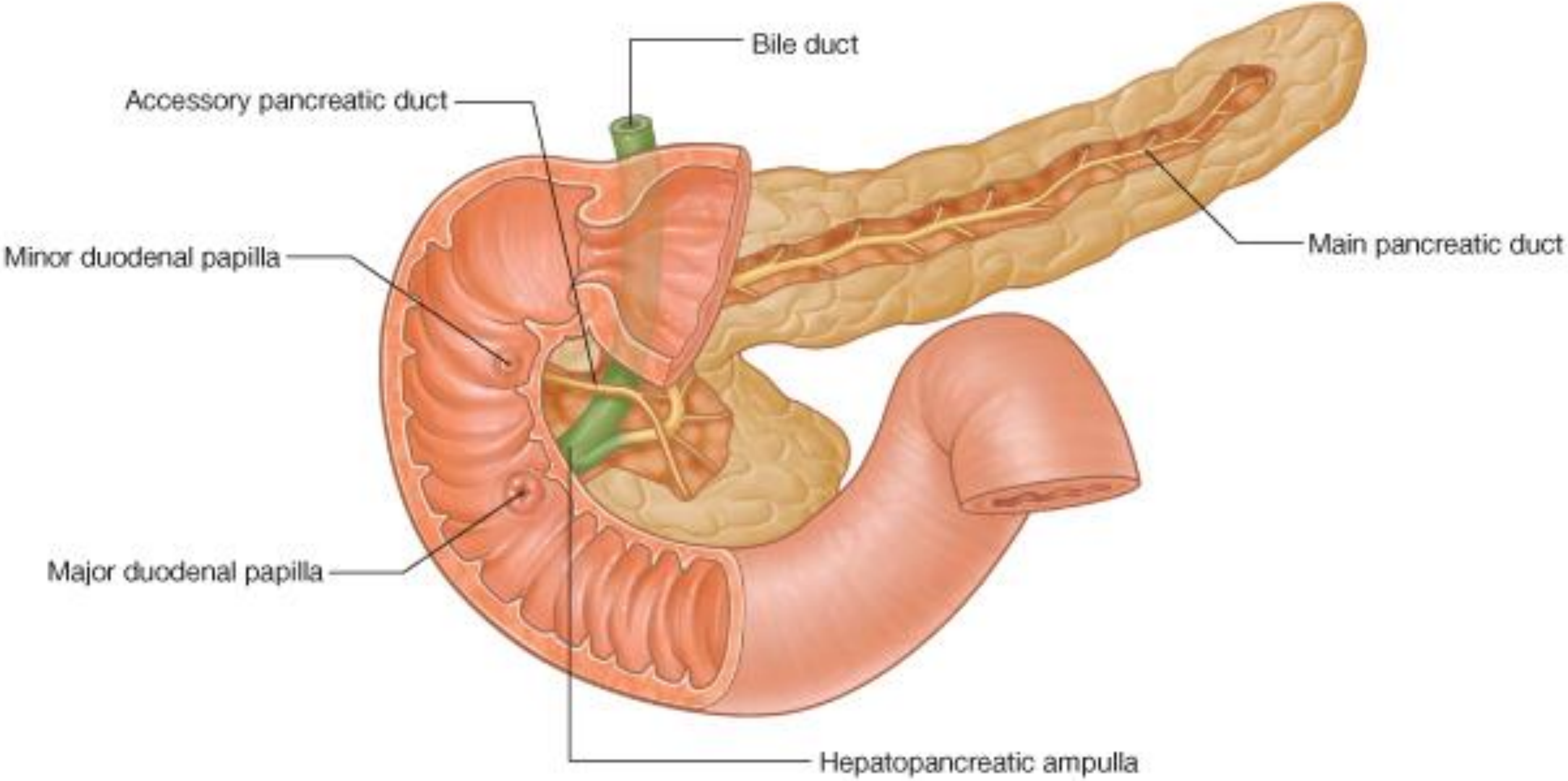
Relations: Parts Of The Duodenum (I)

- **First (Superior)part:**
- **The first 2cm is intraperitoneal.**
- **The distal 3cm of the first part and the other three parts of the duodenum are retroperitoneal.**

Relations: Parts Of The Duodenum (2)

- **First (Superior) part:**
  - Lies anterolateral to the body of the L1 vertebra.
- **Second (Descending) part:**
  - Descends along the right sides of the L1 to L3 vertebrae.
- **Third (Horizontal) part:**
  - Crosses the L3 vertebra.
- **Fourth (Ascending) part:**
  - Begins at the left of the L3 vertebra and rises superiorly as far as the superior border of the L2 vertebra.

Relations (1): to the pancreas and common bile duct



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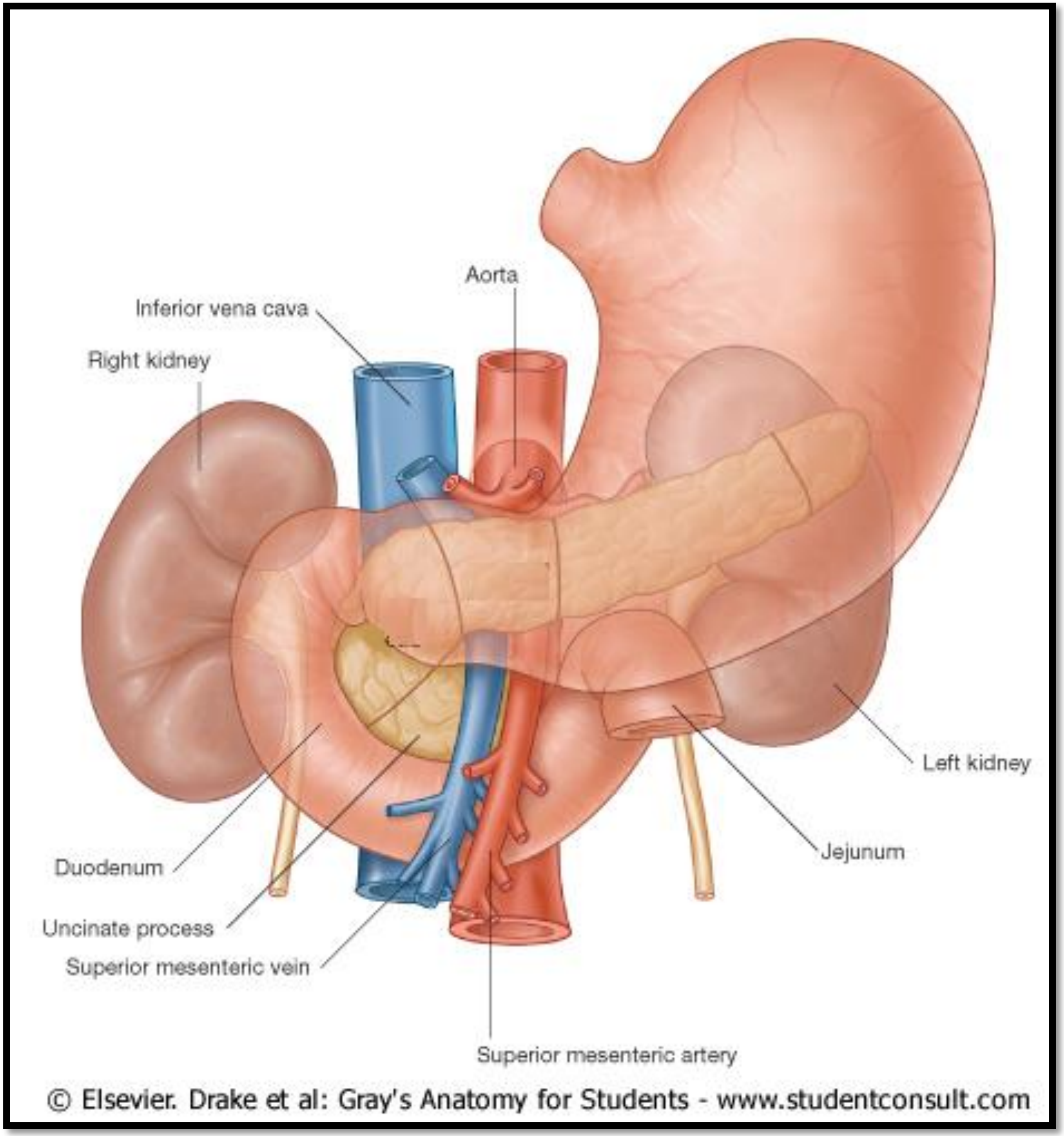
Relations (2): to the kidneys and superior mesenteric vessels



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Relations (3): To The Gallbladder

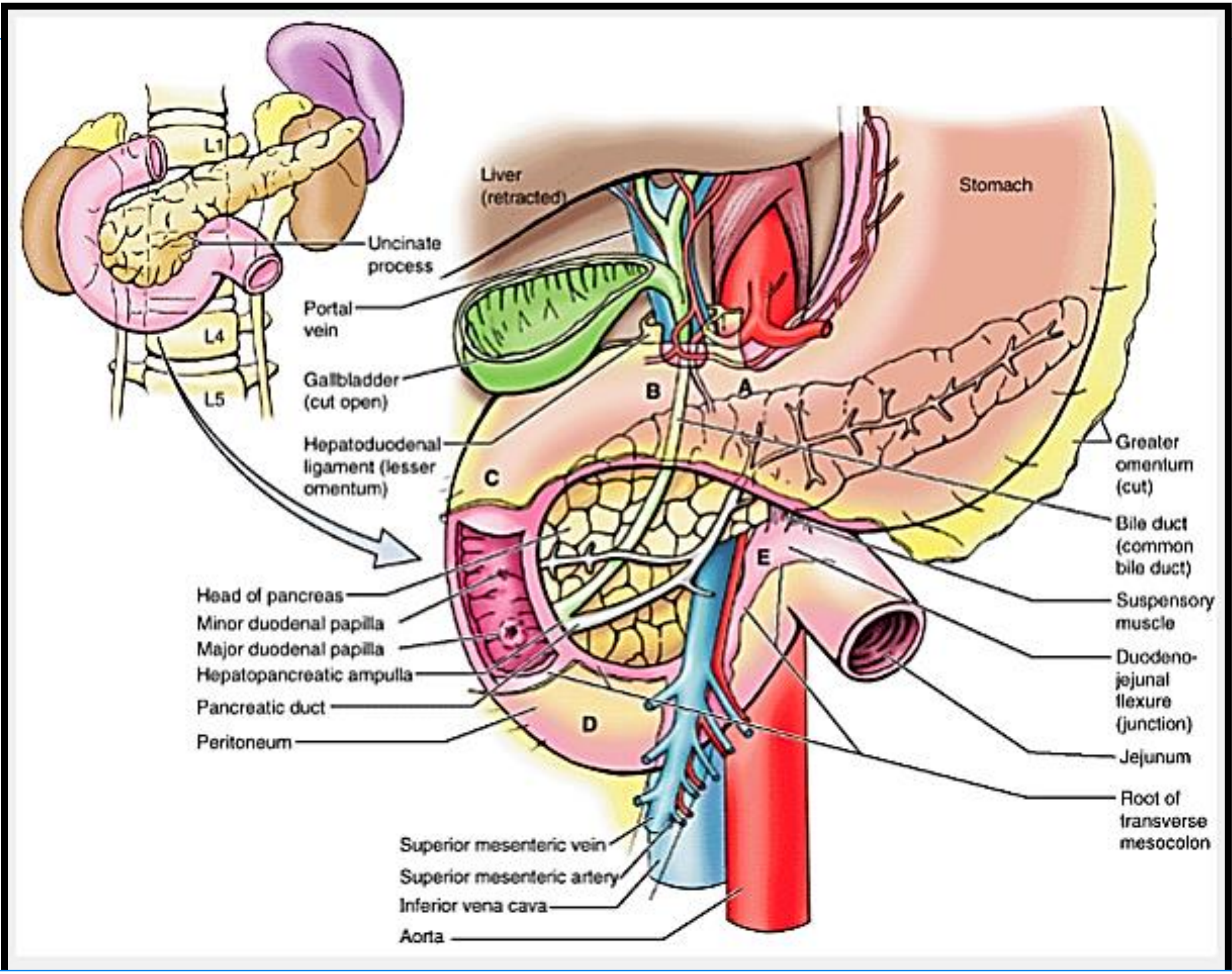
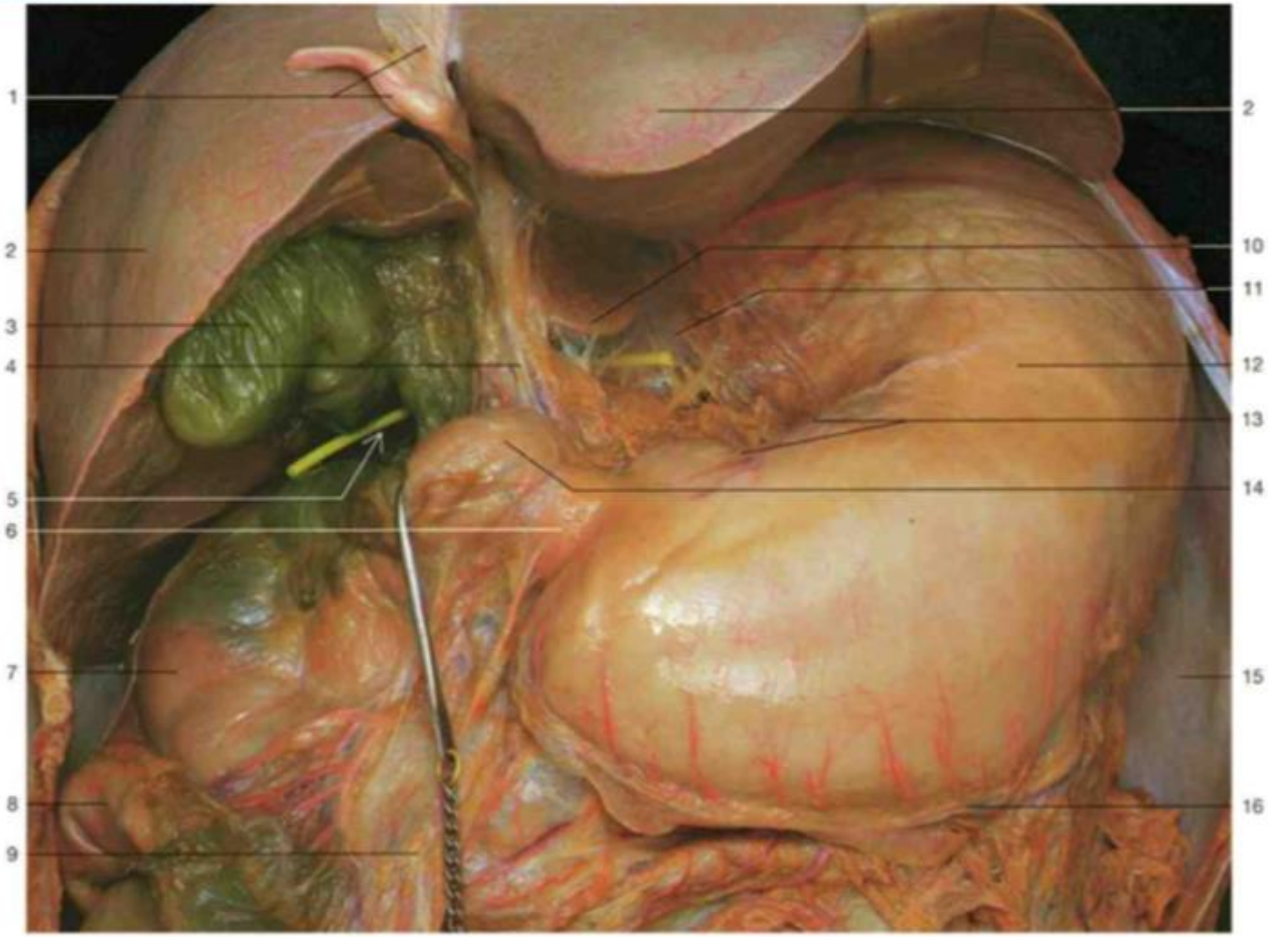


Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

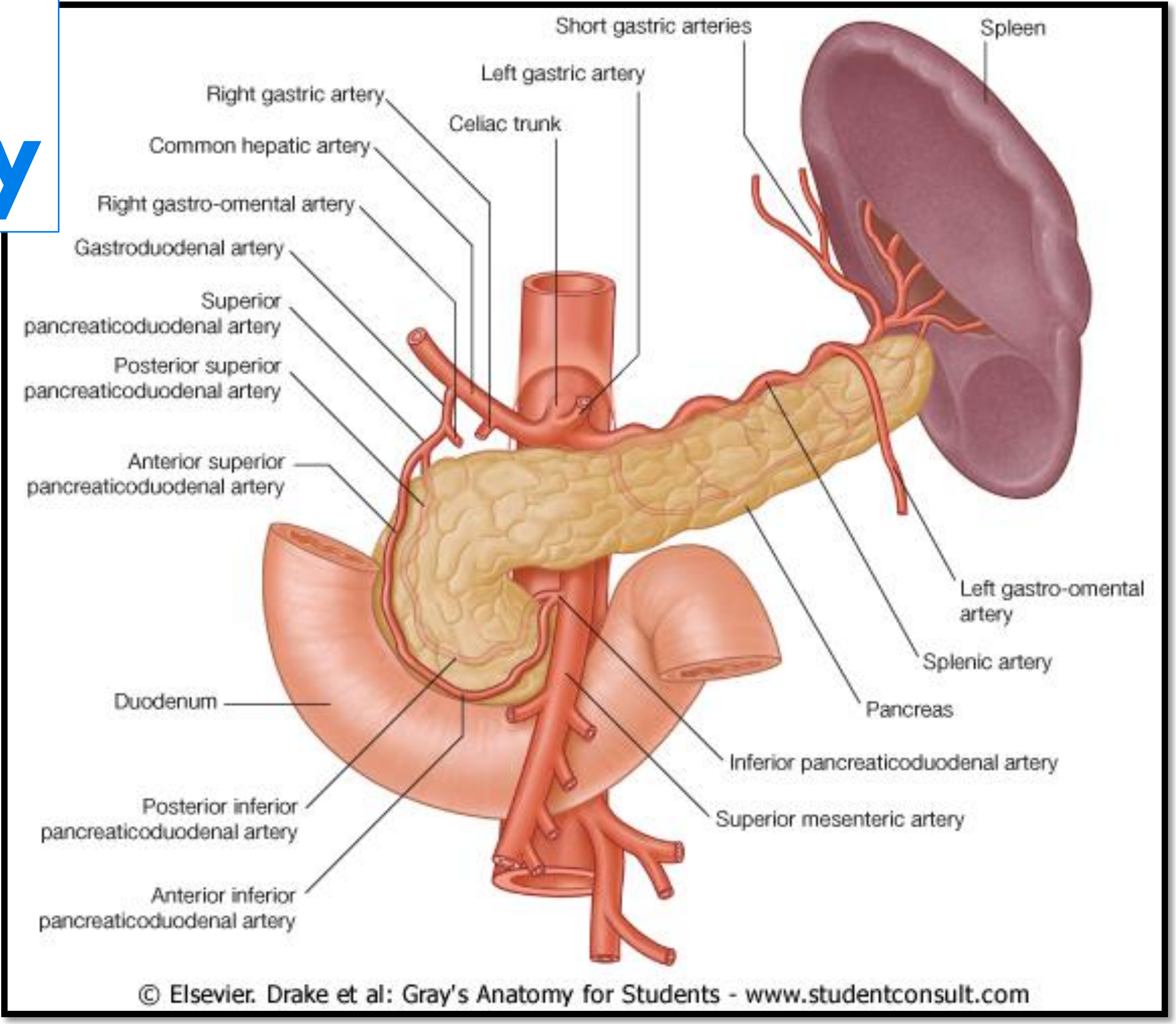


1	Falciform ligament and ligamentum teres
2	Liver
3	Gallbladder (fundus)
4	Hepatoduodenal ligament
5	Epiploic foramen (probe)
6	Pylorus
7	Descending part of duodenum
8	Right colic flexure
9	Gastrocolic ligament
10	Caudate lobe of liver (behind lesser omentum)
11	Lesser omentum
12	Stomach
13	Lesser curvature of stomach
14	Superior part of duodenum
15	Diaphragm
16	Greater curvature of stomach with gastro-omental vessels

Upper abdominal organs (anterior aspect). Thorax and anterior part of diaphragm have been removed and the liver raised to display the lesser omentum. A probe has been inserted into the epiploic foramen and lesser sac.

Image from: Johannes W.Rohen; Chihiro Yokochi; Elke Lütjen-Drecoll. Color atlas of anatomy. 7th edition. Lippincott Williams & Wilkins 2011

Blood Supply


Short gastric arteries
Spleen
Left gastric artery
Right gastric artery
Celiac trunk
Common hepatic artery
Right gastro-omental artery
Gastroduodenal artery
Superior pancreaticoduodenal artery
Posterior superior pancreaticoduodenal artery
Anterior superior pancreaticoduodenal artery
Duodenum
Posterior inferior pancreaticoduodenal artery
Anterior inferior pancreaticoduodenal artery
Left gastro-omental artery
Splenic artery
Pancreas
Inferior pancreaticoduodenal artery
Superior mesenteric artery

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Venous drainage

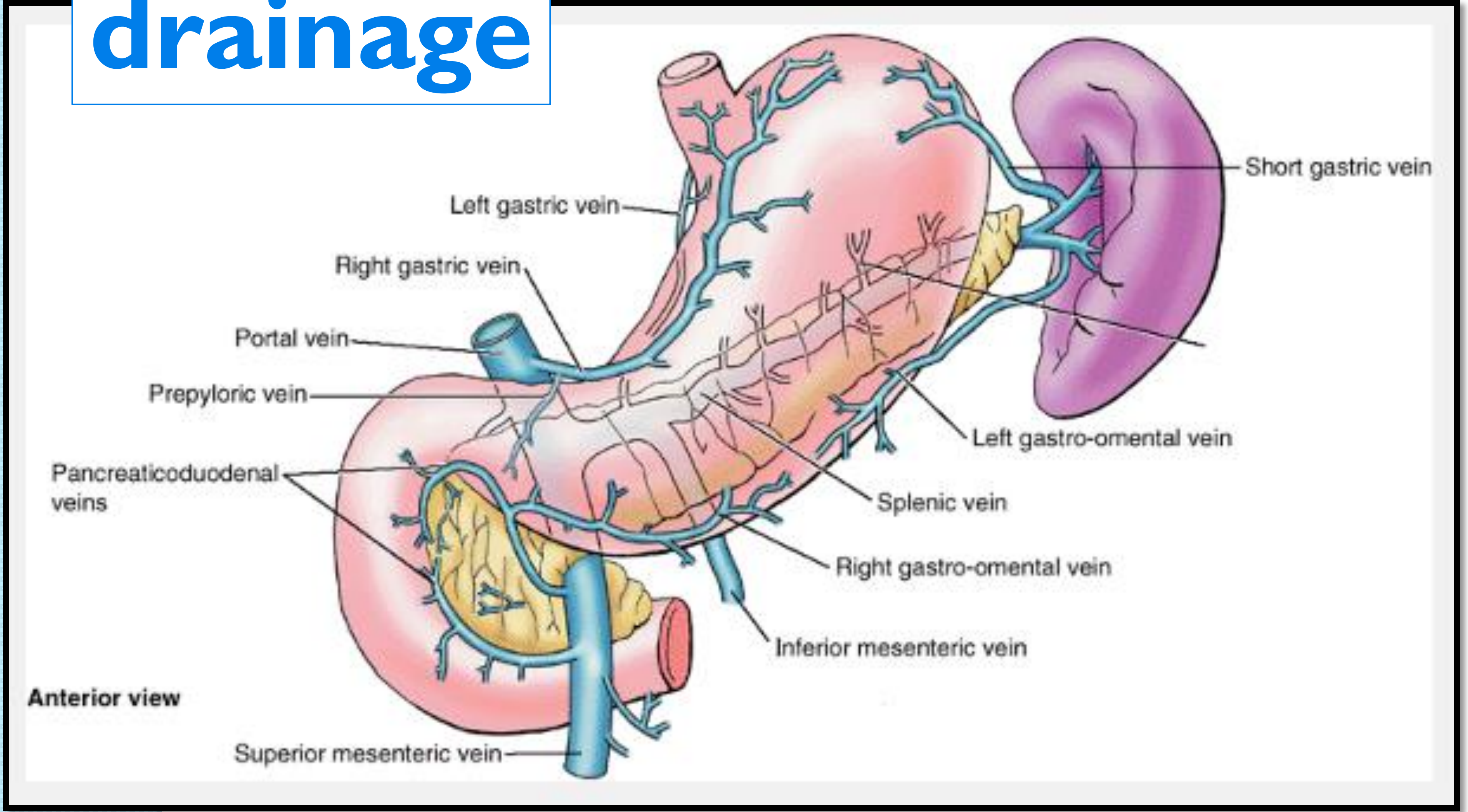

Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Mayo's vein

- A constant vein which crosses the junction of the pylorus with the duodenum.
- Charles Mayo (1865–1939); with his father and his brother, William, founded the Mayo Clinic, Rochester, Minnesota.
- The vein of Mayo was described earlier by Latarjet.

Clinical note: Duodenal Ulcers

- **Duodenal (peptic) ulcers are erosions of the duodenal mucosa.**
- **Most (65%) duodenal ulcers occur in the posterior wall of the superior part of the duodenum.**
- **Posterior ulcer bleeds and Anterior ulcer perforates.**

LYMPH DRAINAGE AND INNERVATION OF THE STOMACH AND DUODENUM

Lymphatics

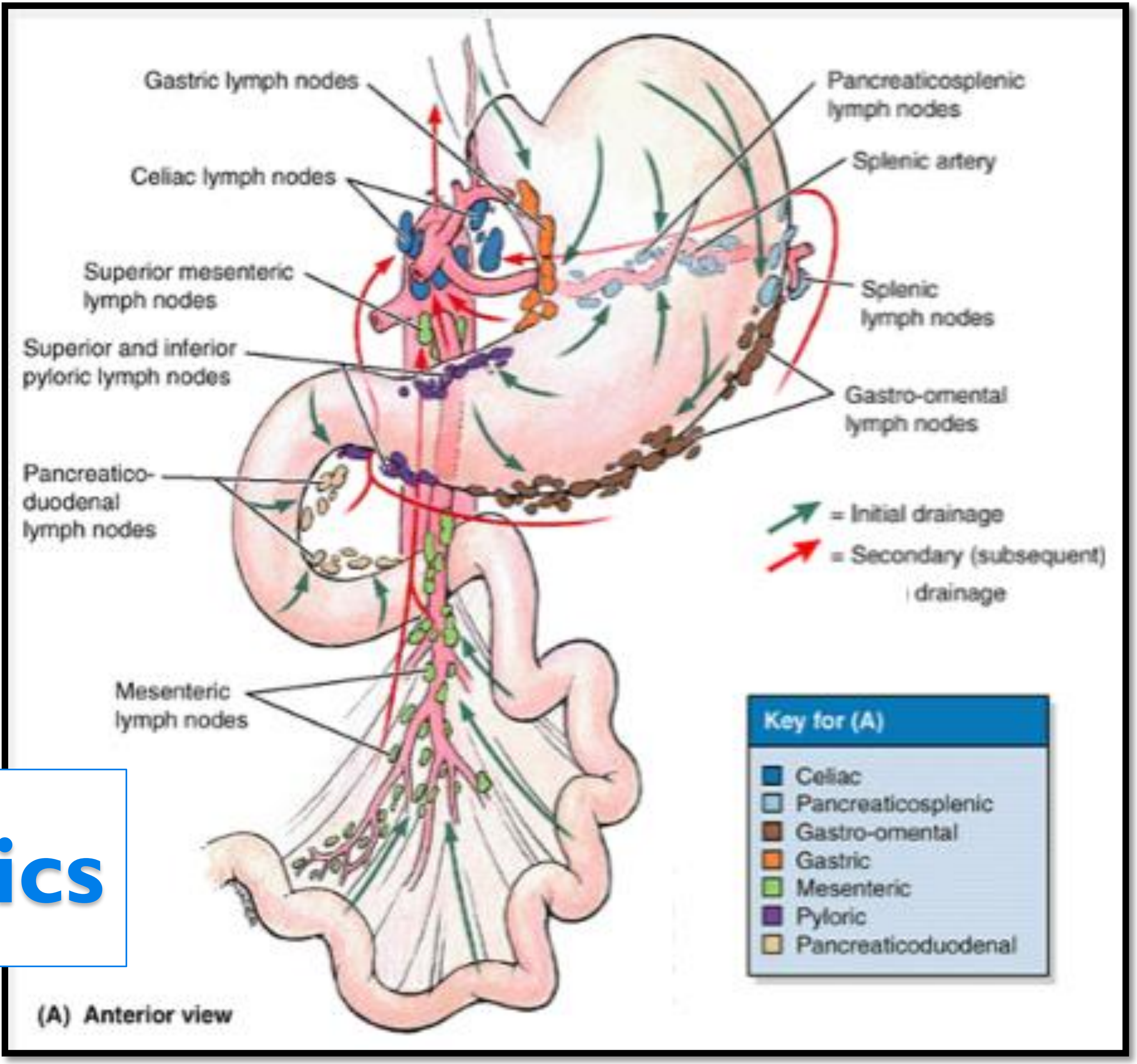

Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Innervation

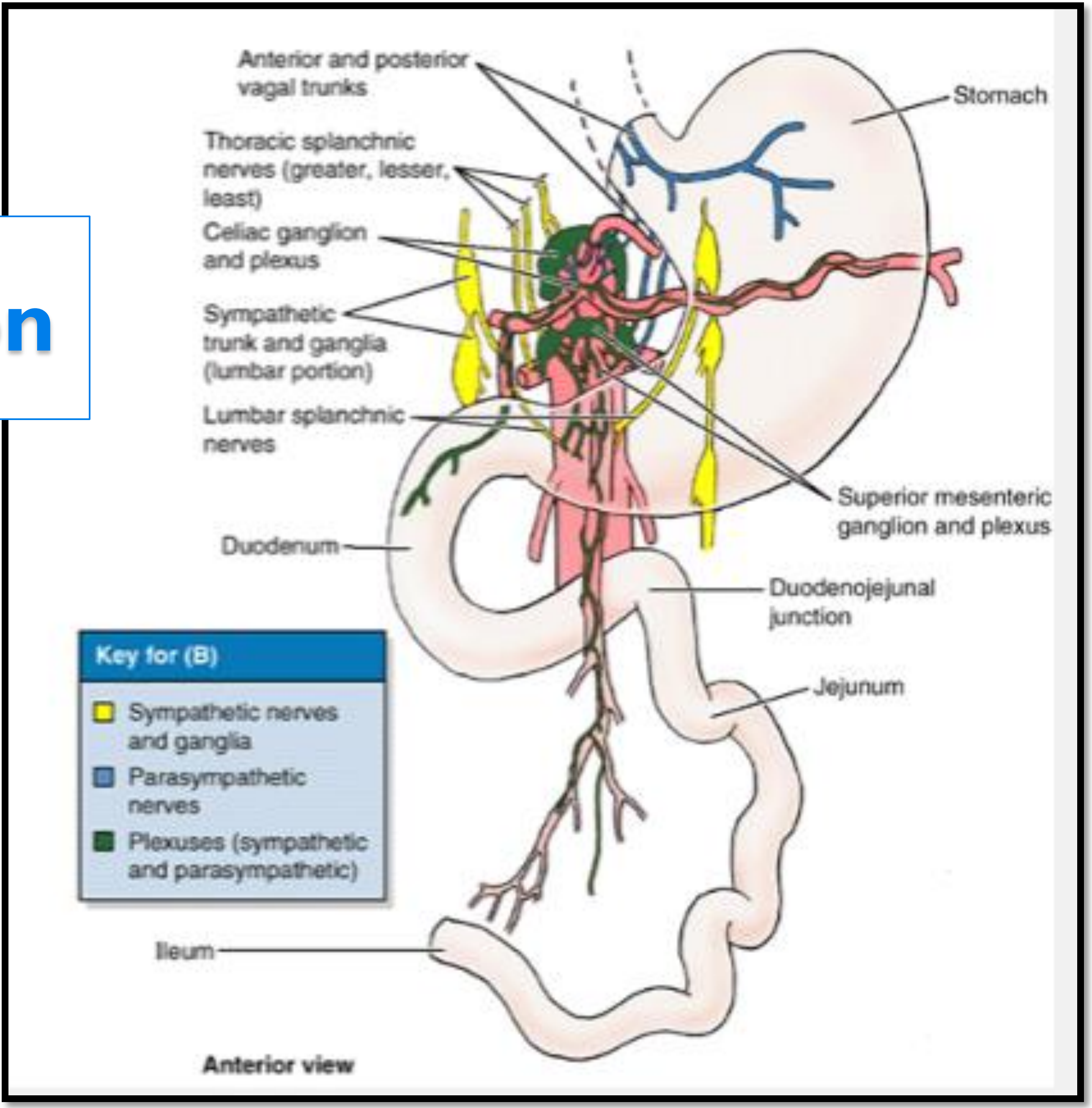
Anterior and posterior vagal trunks
Thoracic splanchnic nerves (greater, lesser, least)
Celiac ganglion and plexus
Sympathetic trunk and ganglia (lumbar portion)
Lumbar splanchnic nerves
Duodenum
Ileum
Stomach
Superior mesenteric ganglion and plexus
Duodenojejunal junction
Jejunum
Key for (B)
🟨 Sympathetic nerves and ganglia
🟦 Parasympathetic nerves
🟩 Plexuses (sympathetic and parasympathetic)
Anterior view

Image from: Moore, Keith L.; Dalley, Arthur F, Clinically Oriented Anatomy, 5th Ed. Lippincott Williams & Wilkins; 2006.

Summary: Lecture's map

- Peritoneum.
- Lower esophagus.
- Stomach.
- Duodenum.

Please Try To Answer The Following Question:

- **The thoracic constriction of the esophagus is due to the presence of:**
  - a) **The cricopharyngeus muscle.**
  - b) **The left main bronchus.**
  - c) **The right crus of the diaphragm.**
  - d) **The left ventricle of the heart.**
  - e) **The arch of the azygos.**

Please Try To Answer The Following Question

- **Which one of the following is a correct description of the second part of the duodenum:**
  - a) **It is intraperitoneal.**
  - b) **It lies at the level of T2 vertebra.**
  - c) **It lies adjacent to the tail of the pancreas.**
  - d) **Common bile duct opens into its medial side.**
  - e) **It curves along the hilum of the left kidney.**

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